TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SELECTED PESTICIDES IN THE OUACHITA RIVER BASIN

303(d) listed subsegments

Bayou Macon – Arkansas State Line to Tensas River (081001)
Big Creek – Headwaters to Boeuf River inc. Colewa Bayou (080903)
Boeuf River – Arkansas State Line to Ouachita River (080901)
Joe's Bayou – Headwaters to Bayou Macon (081002)
Tensas River – Headwaters to Jonesville inc. Tensas Bayou (081201)

US EPA Region 6

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Executive Summary

Eighteen stream segments in the Ouachita River Basin are listed for pesticides on the 1999 court-ordered 303(d) list for Louisiana. Based on new sampling and historical data, only five are shown to be impaired due to pesticides. The remaining 13 stream segments will be delisted. Therefore, this TMDL addresses only those five stream segments shown to be impaired due to pesticides. A watershed approach was used in developing this Total Maximum Daily Load (TMDL). This approach is most appropriate when addressing predominately nonpoint source issues such as pesticides where inputs are distributed throughout the watershed.

This TMDL establishes watershed level controls for the five listed subsegments in the Ouachita River Basin for pesticides including carbofuran, methyl parathion, DDT and toxaphene. This TMDL is based on LDEQ water quality standards for DDT (0.0019 ug/l) and toxaphene (0.00024 ug/l) for the protection of aquatic life in non-drinking waters and EPA developed numeric targets for carbofuran (0.13 ug/l) and methyl parathion (0.17 ug/l) appropriate for freshwater environments. It is assumed that the listed subsegments have no assimilative capacity for pesticide loading at concentrations above the water quality standards or numeric targets for fresh waters. The wasteload (WLA) and load allocation (LA) cumulatively for the Ouachita River Basin should not cause or contribute to exceedances of these numeric targets. Attainment of the narrative objective for toxicity and protection of the freshwater habitat and wildlife habitat beneficial uses for these watersheds is expected because carbofuran and methyl parathion have restricted use application. DDT and toxaphene were banned in 1972 and 1990, respectively, so there should be no new inputs into the environment. In addition to the TMDL values, no introduction of carbofuran or methyl parathion, which causes local concentrations to be greater than the numeric target, will be authorized. It is recommended that routine ambient quarterly monitoring data be analyzed annually to determine compliance with the appropriate state water quality standard, national criterion and TMDL target values for freshwater environments. Additionally, it is recommended fish tissue levels for DDT and toxaphene be monitored in the Tensas River to assess the necessity for continued fish advisories and in the Boeuf River to assess the necessity for a new fish advisory.

Carbofuran is a broad-spectrum carbamate pesticide. It is classified as a RUP because of its acute oral and inhalation toxicity to humans. LDAF reports the liquid form is occasionally approved for the use on cotton crops for the control of cotton aphids when other measures fail, corn and soybeans crops.

Methyl parathion, also a RUP, is an organophosphate insecticide and acaricide used to control chewing and sucking insect pests in a wide range of crops including alfalfa, corn, cotton, soybeans, sweet potatoes and wheat.

DDT is an organochlorine insecticide with wide use application including most agricultural insects, pest control in buildings, mosquito control in urban areas, and by the military in WWII to control mosquitoes, body lice and fleas responsible for outbreaks of malaria, typhus and bubonic plague. Because of damage to wildlife and the potential harm to human

health, most uses of DDT and all uses of DDE were banned by EPA in December 1972. DDT is highly persistent in the environment and tissue of plants and animals and could take decades to degrade. People who eat large quantities of fish and shellfish, which have been contaminated with DDT, are at risk of being exposed.

Toxaphene, one of the most heavily used insecticides in the United States, was partially banned in 1982 and fully banned in 1990. It was widely used in the southern United States to control insect pests on cotton and other crops. It was also used to control insect pests on livestock and to kill unwanted fish in lakes. Like, DDT, toxaphene is highly persistent in the environment and tissues of fish and mammals. People who eat large quantities of fish and shellfish, which have been contaminated with toxaphene, are at risk of being exposed.

In a Federal Register notice dated January 14, 2003, EPA withdrew the EPA established TMDL for atrazine in the water column for Louisiana subsegment 080903, Big Creek from the confluence with the Boeuf River to the headwaters (including Big Colewa Bayou) dated March 2002. EPA withdrew this TMDL because the draft criteria value for atrazine used in screening the waterbody to determine whether it meets Louisiana water quality standards and for calculation of allowable load allocations was draft only and had not been through the complete public notice process and had not been finalized. In place of the draft atrazine criteria number of 12 ug/l, EPA is established a screening value of 36 ug/l as calculated by one possible procedure found in Louisiana water quality standards (LAC 33:IX,1113.C.6.). Based on this new screening value of 36 ug/l, Big Creek is not, and was not at the time EPA established this TMDL, impaired by atrazine and should not have been listed on Louisiana's 1993 3039d) list for atrazine. Therefore, this TMDL has been revised to reflect the above information and replaces the final TMDL dated March 2002.

List of Abbreviations

CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
CWA	Clean Water Act
EPA	Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
LA	Load Allocation
LC_{50}	Concentration at which 50% of the test organisms die
LASS	Louisiana Agricultural Statistics Service
LDAF	Louisiana Department of Agriculture and Forestry
LDEQ	Louisiana Department of Environmental Quality
LDHH	Louisiana Department of Health and Hospitals
LDFW	Louisiana Department of Fish and Wildlife
MCL	Maximum Contaminant Level
MISE	Mississippi Embayment
MOS	Margin of Safety
NAWQA	National Water Quality Assessment
NPDES	National Pollutant Discharge Elimination System
OPH	Office of Public Health (part of LDHH)
OWR	Office of Water Resources (part of LDEQ)
RUP	Restricted Use Pesticide
TMDL	Total Maximum Daily Load
ug/l	Micrograms Per Liter
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WLA	Wasteload Allocation

1.0 Introduction

Section 303(d) of the Clean Water Act (CWA) as amended by the Water Quality Act of 1987, and EPA's regulations at 40 CFR 130 require that each state identify those waters within its boundaries not meeting water quality standards. Section 303(d) of the CWA further requires that states develop TMDL management plans for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating the State's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLAs) for point sources and Load Allocations (LAs) for nonpoint sources, including a margin of safety (MOS) and natural background conditions.

1.1 General Land Use Description

The primary landuse in the Ouachita River Basin, located in north central and northeastern Louisiana, is agriculture. The eastern portion of the basin, located in the Mississippi River floodplain, is prime farmland. The top three crops grown include cotton, corn and soybeans. Secondary crops in this basin include rice, sorghum, sweet potatoes, and winter wheat. Figure 1 depicts the Ouachita River Basin.

Farming practices are fairly uniform throughout the basin. According to the National Agricultural Statistics Service (NASS) (2000), corn and rice are typically planted in March through April. Cotton, sorghum, and soybeans are planted in April through May and sweet potatoes are planted later in May through June. Wheat is planted late September through November. Irrigation is primarily by flooding. Rice is flooded in May, soybeans are irrigated in June through July, and cotton is irrigated in July. Rice fields are typically drained in late August through September. Aside from winter wheat, much of the land is bare from November through March.

Subsegment descriptions and land uses are detailed below. Land use classifications and areas were determined using the National Land Cover Data (NLCD). The NCLD was produced as a cooperative project between the U.S. Geological Survey (USGS) and the U.S. Environmental Protection Agency (USEPA) to produce a consistent, land cover data layer. It is approximately 1995 satellite interpreted data. The data values are 30 meter resolution and in "grid" format. The subsegment areas were provided by the State of Louisiana and are 1999 vintage. In order to better understand the agricultural uses in this basin, land use areas were determined for row crops, small grains, and hay/pasture. Typical row crops include cotton, corn, soybeans, and sweet potatoes. Small grains include winter wheat, sorghum and rice.

Based on 30-years of reporting records (1961-1990), the average annual precipitation for the Northeast Weather Division and North Central Weather Division are 55.23 inches and 54.24 inches, respectively (Grymes, 2000).

2.0 Assessment Method

2.1 Problem Statement

Eighteen subsegments in the Ouachita River Basin were included on the 1999 court-ordered Louisiana 303(d) list as not fully supporting the water quality standard with "pesticides" listed as the cause of nonsupport. These original assessments were based largely on the best professional judgment of Louisiana Department of Environmental Quality (LDEQ) regional coordinators, often without the benefit of quantitative data. The rationale for many of these listings was the fact that since the predominant land use is agriculture, then the possibility for pesticide impairment in the watershed existed. This is further supported by the fact that no specific pesticide was identified as the problem, only pesticides in general. Therefore, informal, qualitative observations rather than quantitative data were the basis for many of these listings. Because the listings are for pesticides in general, the first step was to identify which pesticide, if any, may be contributing to water quality standards impairments.

2.2 Water Quality Standards

Designated uses for the subsegments listed in Table 1 include primary and secondary contact recreation, propagation of fish and wildlife, drinking water, and outstanding natural resource waters. This TMDL will result in the protection of existing uses, which conforms to LDEQ's antidegradation policy.

Narrative criterion for toxic substances may be found in the Louisiana Water Quality Standards at §1113.B.5. This reads:

> "No substances shall be present in the waters of the state or the sediments underlying said waters in quantities that alone or in combination will be toxic to human, plant, or animal life or significantly increase health risks due to exposure to the substances or consumption of contaminated fish or other aquatic life. The numerical criteria (LAC 33:IX.1113.C.6) specify allowable concentrations in water for several individual toxic substances to provide protection from the toxic effects of these substances. Requirements for the protection from the toxic effects of other toxic substances not included in the numerical criteria and required under the general criteria are described in LAC 33:IX.1121. "

Criteria for toxic substances may be found in the Louisiana Water Quality Standards at §1113.C.6. This reads:

> 6b. The criteria for protection of aquatic life are based on acute and chronic concentrations in fresh and marine waters as specified in the EPA criteria documents and are developed primarily for attainment of the fish and wildlife propagation use. Where a specific numerical criterion is not derived in EPA criteria documents, a criterion is developed by applying an appropriate application factor for acute and chronic effects to the lowest LC50 value for a representative Louisiana species.
>
> 6c. Criteria for human health are derived using EPA guidelines, procedures, and equations for water bodies used as drinking water supplies and those not used as drinking water supplies. Criteria applied to water bodies designated as drinking water supplies are developed to protect that water supply for human consumption, including protection against taste and odor effects, to protect it for primary and secondary contact recreation, and to prevent contamination of fish and

aquatic life consumed by humans. Criteria for water bodies not designated as drinking water supplies are developed to protect them for primary and secondary contact recreation and to prevent contamination of fish and aquatic life consumed by humans. In some cases, the maximum contaminant levels (MCLs) from the National Drinking Water Regulations, when more restrictive, are used as the criteria. For those toxic substances that are suspected or proven carcinogens, an incremental cancer risk level of 10^{-6} (1 in 1,000,000) is used in deriving criteria, with the exception of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and hexachlorocyclohexane (lindane, gamma BHC), in which case 10^{-5} (1 in 100,000) is used to derive the criteria.

Table 1. Court ordered listing (1999) for the Ouachita River Basin.

Subsegment	Station Description	Designated Uses
080101	Ouachita River- Arkansas State Line to Columbia L&D.	A,B,C,D
080201	Ouachita River- Columbia L&D to Jonesville	A,B,C
080301	Black River- Jonesville to COE Structure at Serena (Mile 25)	A,B,C
080302	Black River – Corps of Engineers Structure to Red River	A,B,C
080902	Bayou Bonne Idee- Headwaters to Boeuf River	A,B,C
080905	Turkey Creek- Headwaters to Big Creek (inc. Glade Slough)	B,C
080909	Crew Lake	A,B,C
080910	Clear Lake	A,B,C
081002	Joe's Bayou- Headwaters to Bayou Macon	A,B,C
081201	Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	A,B,C
081202	Lake St. Joseph (Oxbow Lake)	A,B,C
080202	Bayou Louis	A,B,C
080401	Bayou Bartholomew- Arkansas State Line to Dead Bayou	A,B,C,G
080901	Boeuf River- Arkansas State Line to Ouachita River	A,B,C
080903	Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	A,B,C
080904	Bayou Lafourche- Near Oakridge to Boeuf River nr. Columbia	A,B,C
081001	Bayou Macon- Arkansas State Line to Tensas River	A,B,C
081203	Lake Bruin (Oxbow Lake)	A,B,C,D

A – primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife
D – drinking water; G – outstanding natural resource waters

2.3 Evaluation Methodology

As mentioned previously, eighteen LDEQ subsegments were listed on the court-ordered list as being impaired by pesticides. A primary presumption was made that the listings were based on concerns that the LDEQ water quality standard addressing no toxics in toxic amounts was being violated. It is not possible to develop a TMDL for a generic listing of pesticides. Therefore, one of the first steps was to establish which, if any, pesticide may be contributing to impairment of the listed subsegments. LDEQ has adopted numeric criteria for a number of pesticides, including; Aldrin, Chlorodane, DDT, TDE (DDD), DDE, Dieldrin, Endosulfan, Endrin, Heptachlor, Lindane and Toxaphene. It was recognized that this list of pesticides is very limited and does not fully represent concerns from currently used pesticides. A procedure for identifying current pesticide concerns was developed using LDAF pesticide monitoring program information.

The LDAF data set targets pesticides for monitoring according to crop types in the watershed above each established station. The LDAF monitoring program targets pesticides for monitoring by establishing crop types for a given area and then a generating a list of the pesticides approved for use on those crops. It was determined that this list would be

representative of pesticides reasonably expected to be present and would define the basis list for further pesticide evaluations.

Once a pesticide has been identified, a numeric target value for that pesticide which distinguishes between the impaired and unimpaired state of the waterbody must be established. A number of the identified pesticides do not have state adopted water quality standards. In the absence of numeric criteria for these pesticides, a numeric target needed to be developed These numeric target values do not represent a water quality criterion or standard; rather, they are a numeric target used to assess if a water body would be reasonably expected to be impaired based on the state's no toxics in toxic amounts narrative criterion. These numeric target values were established in accordance with procedures outlined in the State of Louisiana Water Quality Standards for toxics and supporting documentation submitted to EPA Region 6 (Appendix B-1). A more comprehensive description can be found in Appendix B-2 "Rationale for Development of Screening Levels in Louisiana 303(d) Streams Listed for Pesticides".

Two data sets were available to provide data that were considered in determining if a subsegment was indeed impaired due to pesticides. These include the LDAF quarterly ambient monitoring station network data from May 1998 through June 2001(Appendix D) and the USGS NAWQA study data from June 1998 through January 2000 for the Tensas River (Appendix E). It was determined, after a review of this existing data, that additional sampling would be needed to supplement this information. EPA conducted a pesticide study targeted at the eighteen 303(d) listed subsegments (Table 2) in the Ouachita River Basin. Twenty-two sites were identified (Figure 1), one at the lower end of each listed subsegment and an additional site at the state line when a subsegment crossed the state line. Samples were collected monthly from April 2001 and continued through September 2001. This time interval was targeted because it represents a time of intense agricultural activity. Whole water column samples were analyzed for the pesticides for which LDEQ had adopted water quality standards including Aldrin, Chlorodane, DDT, DDD, DDE, Dieldrin, Endosulfan, Endrin, Heptachlor, Lindane and Toxaphene in addition to those pesticides commonly used in agriculture for this basin (diazinon, methyl parathion, molinate and carbofuran). Only five of the eighteen listed subsegments were found to be impaired due to one or more pesticides. Lab results are reported for the pesticides carbofuran, DDT, methyl parathion and toxaphene in Appendix C.

Once numeric targets were established, and data collection was complete, the most recent three years (May 1998 – June 2001) of data from each of the three data sets were reviewed with respect to the LDEQ established water quality standards, EPA proposed water quality criteria or calculated numeric target values. Exceedances of either the acute or chronic numeric target values were noted for each impaired water body. If a pesticide concentration did not exceed its numeric target value or standard more than once in a three-year period, the water body was considered to be fully supporting. This is consistent with EPA 305(b) guidance (EPA, 1997) for assessing waterbodies. If a pesticide concentration exceeded its numeric target value or standard two or more times during a three year period, the percentage of samples in which this occurred was used to further assess the water body as either partially supporting or not supporting with regard to the pesticide of concern. Water bodies identified as partially supporting or not supporting require a TMDL.

Table 2. Summary of exceedance data from all sources (EPA, LDAF, NAWQA)

Pesticide	Data Source	Site Description	Subsegment	Station	Date	Conc. ug/l	Numeric Target (ug/l)
Carbofuran	LDAF	Big Creek @ Hwy 80	80903	WM-S-M-03	May-00	0.58	0.13
	EPA Study	Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	Jul-01	0.16	
	LDAF	Boeuf River @ Hwy 2	80901	WM-S-M-01	May-00	0.65	
	EPA Study	Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	Apr-01	0.14	
	EPA Study	Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	Apr-01	0.88	
	EPA Study	Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	May-01	0.95	
	EPA Study	Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	Jun-01	0.19	
	NAWQA	Tensas R @ Tendall	81201	7369500	May-98	0.25	
	NAWQA	Tensas R @ Tendall	81201	7369500	Jun-98	0.37	
	NAWQA	Tensas R @ Tendall	81201	7369500	Mar-99	0.81	
	NAWQA	Tensas R @ Tendall	81201	7369500	Apr-99	0.33	
	NAWQA	Tensas R @ Tendall	81201	7369500	May-99	0.37	
	NAWQA	Tensas R @ Tendall	81201	7369500	Jun-99	0.35	
	EPA Study	Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	Apr-01	0.44	
	EPA Study	Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	May-01	0.17	
DDT	EPA Study	Bayou Macon- Arkansas State Line to Tensas River	81001	17.2	Apr-01	0.0038	0.01
	EPA Study	Bayou Macon- Arkansas State Line to Tensas River	81001	17.2	May-01	0.0022	aquatic life
	EPA Study	Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	Apr-01	0.0047	
	EPA Study	Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	Jun-01	0.0018	0.00019
	EPA Study	Boeuf River (Arkansas State Line)*	80901	14.1	Apr-01	0.0012	human
	EPA Study	Boeuf River (Arkansas State Line)*	80901	14.1	Jun-01	0.0044	health
	EPA Study	Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	Apr-01	0.0021	
	EPA Study	Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	Jun -01	0.0015	
	EPA Study	Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	Apr-01	0.0024	
	EPA Study	Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	May-01	0.0015	
	EPA Study	Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	Apr-01	0.0024	fish advisory
Methyl Parathion	LDAF	Big Creek @ Hwy 80	80903	WM-S-M-03	Aug-99	0.30	0.17
	EPA Study	Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	Apr-01	0.28	
Toxaphene	EPA Study	Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	(fish advisory)		0.0002
	EPA Study	Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	Jun -01	0.103	aquatic life
	EPA Study	Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	Apr-01	0.078	0.00024 human health

2.4 Evaluation Results

Only five of the eighteen 303(d) listed subsegments had pesticide values greater than the appropriate water quality standard or numeric target. These include Bayou Macon (subsegment 081001), Big Creek (subsegment 080903), Boeuf River (subsegment 080901), Joe's Bayou (subsegment 081002) and Tensas River (subsegment 081201). All of these have designated uses of primary and secondary contact recreation and propagation of fish and wildlife.

Figure 1. Map of the Ouachita River Basin showing the EPA monitoring sites (red triangle), LDAF monitoring sites (blue dot) and USGS monitoring site (star).

Methyl parathion and carbofuran were the only pesticides found in concentrations reasonably expected to be harmful to freshwater aquatic life or human health. Methyl parathion exceeded the numeric target in Big Creek (subsegment 080903) (Figure 2). Carbofuran exceeded the numeric target in four subsegments including Big Creek (080903), Boeuf River (080901), Joe's Bayou (081002) and Tensas River (081201) (Figure 3).

DDT exceeded the LDEQ water quality standard of 0.001 for freshwater aquatic life protection and 0.00019 ug/l for human health protection in a non-drinking water supply in five subsegments including Bayou Macon (081001), Big Creek (080903), Boeuf River (080901), Joe's Bayou (081002) and Tensas River (081201) (Figure 4). The human health protection criterion is protective of primary and secondary contacted recreation and fish consumption. In addition, a fish consumption advisory for DDT was issued February 19, 1992 for 83 miles of the Tensas River (Madison, Tensas, and Catahoula Parishes) by the Louisiana Department of Health and Hospitals (LDHH) Office of Public Health (OPH), the Louisiana Department of

Environmental quality (LDEQ) and the Louisiana Department of Agriculture and Forestry (LDAF).

Toxaphene concentrations from the EPA pesticide study exceeded the minimum detection level (MDL) of 0.06 ug/l on three occasions, twice in the Boeuf River (subsegment 080901) and once in Bayou Macon (subsegment 081001) (Figure 5). The Louisiana water quality standard for toxaphene is 0.0002 ug/l for freshwater aquatic life protection and 0.00024 for human health protection in a non-drinking water supply. Exceedance of the MDL for toxaphene is considered an exceedance in the water quality standard. A TMDL is necessary for the Boeuf River because two exceedances have occurred in fewer than 3 years. A fish consumption advisory for toxaphene was issued February 19, 1992 for 83 miles of the Tensas River (Madison, Tensas, and Catahoula Parishes) by the Louisiana Department of Health and Hospitals (LDHH) Office of Public Health (OPH), the Louisiana Department of Environmental quality (LDEQ) and the Louisiana Department of Agriculture and Forestry (LDAF). Although toxaphene concentrations from the EPA pesticide study did not exceed the MDL in the Tensas River, the presence of a fish advisory is justification for the TMDL.

3.0 Pesticide Information

3.1 Carbofuran

Carbofuran is a broad-spectrum carbamate pesticide that kills insects, mites, and nematodes on contact or after ingestion. It is used against soil and foliar pests of field, fruit, vegetable and forest crops. Carbofuran is available in liquid, powdered and granular formulations; however, the granule form was banned in the U.S in 1994. Formulations of carbofuran are in toxicity class I – highly toxic or toxicity class II – moderately toxic. FMC Corporation is the primary manufacturer (Extoxnet 1996). Prior to 1991, 80% of the total usage of carbofuran was in granular formulations, which were very effective for controlling rice weevil infestations. Granular carbofuran was used exclusively in rice farming to control the rice weevil. Table 2. summarizes the exceedance data from all sources (EPA, LDAF, NAWQA). There is no ban on liquid or powdered formulations of carbofuran. These formulations are classified as Restricted Use Pesticides (RUP) because of their acute oral and inhalation toxicity to humans. LDAF reports that liquid and powered forms of carbofuran are not used in rice farming; however, liquid formulations are used in cotton and wheat production with prior approval from LDAF. This is the only current use of carbofuran in Louisiana.

Carbofuran is soluble in water and is moderately persistent in soil. Its soil half-life is 30 to 120 days. In soil, chemical hydrolysis and microbial processes degrade carbofuran. Hydrolysis occurs more rapidly in alkaline soils (Howard, 1991). Photodegradation also contributes to the breakdown of carbofuran. Carbofuran has a high potential for groundwater contamination. It is mobile to very mobile in sandy loam, silty clay, and silty loam soils; moderately mobile in silty clay loam soils; and only slightly mobile in muck soils (Howard, 1991).

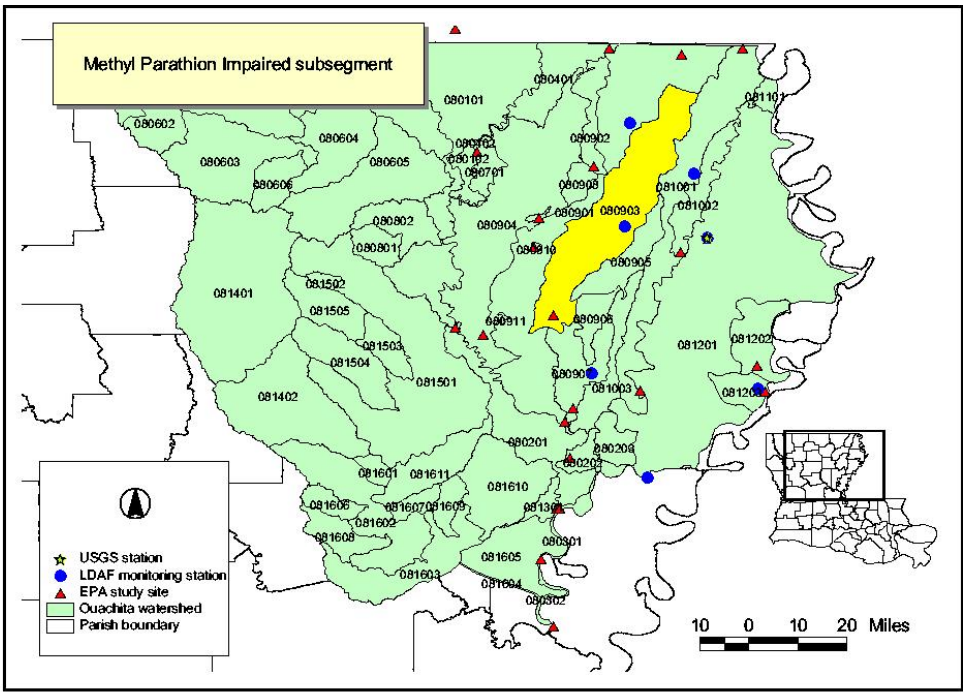

Figure 2. Methyl parathion impaired subsegments in the Ouachita River Basin.

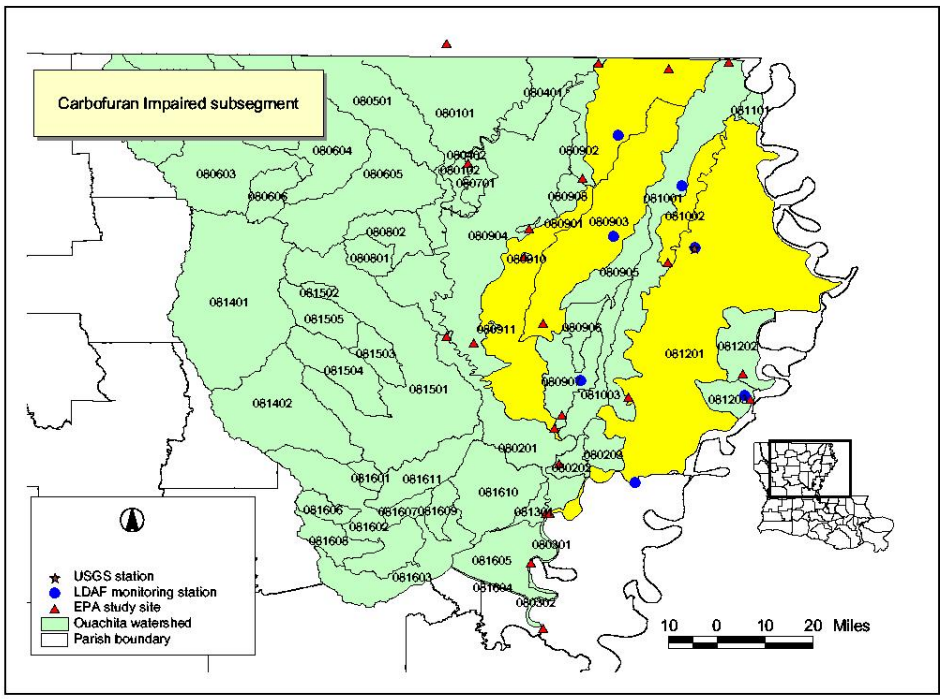

Figure 3. Carbofuran impaired subsegments in the Ouachita River Basin

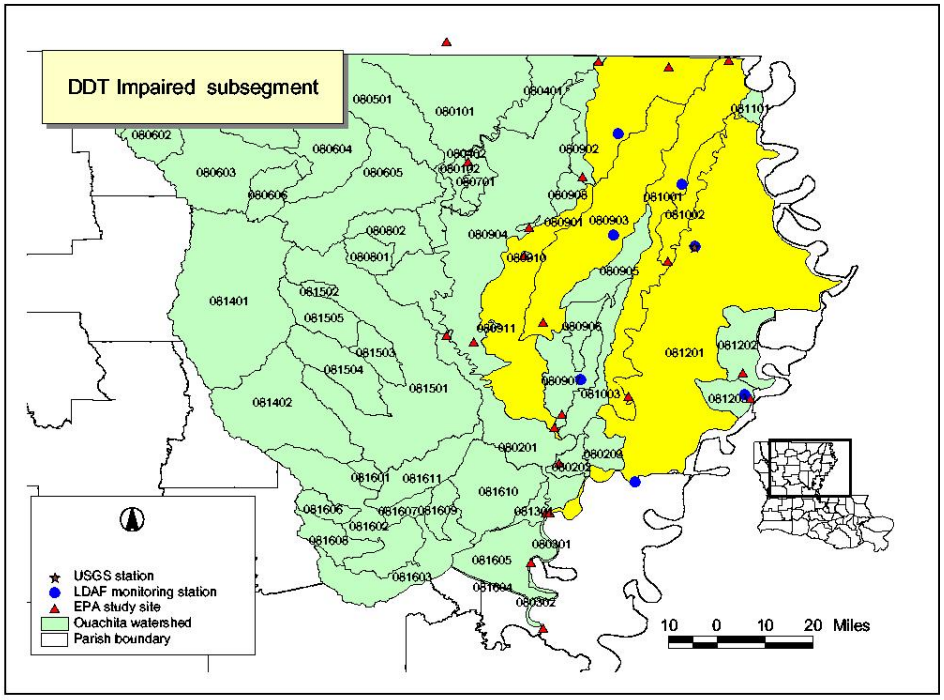

Figure 4. DDT impaired subsegments in the Ouachita River Basin

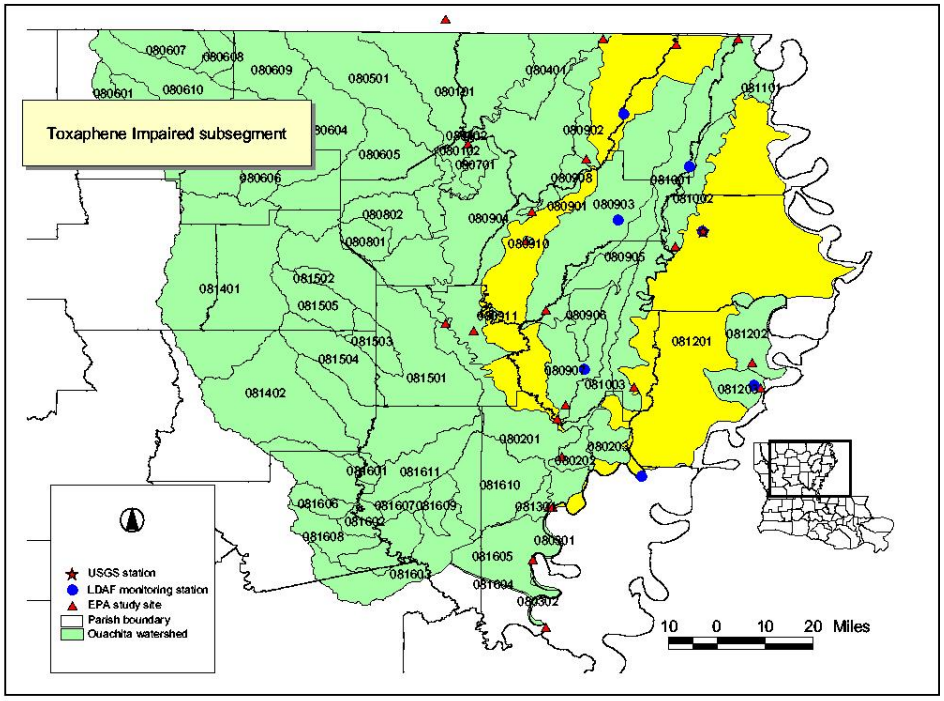

Figure 5. Toxaphene impaired subsegments in the Ouachita River Basin

In water, carbofuran is subject to degradation by chemical hydrolysis under alkaline conditions. Photodegradation and aquatic microbes may also contribute to degradation. The hydrolysis half-lives of carbofuran in water at 25^{o}C are 690, 8.2, and 1.0 weeks at pH values of 6.0, 7.0, and 8.0, respectively. Carbofuran does not volatilize from water, nor does it adsorb to sediment or suspended particles (Howard, 1991).

Carbofuran is highly toxic to many fish. The LD50 (96-hour) is 0.24 mg/L in bluegill sunfish (Kidd and James, 1991). The compound has a low potential to accumulate in aquatic organisms.

3.2 Methyl Parathion

Methyl parathion is an organophosphate insecticide and acaricide used to control chewing and sucking insect pests in a wide range of crops including alfalfa, corn, cotton, soybeans, sweet potatoes and wheat to name a few (PAN International 1995, Extoxnet 1996, EPA 1999a). Some or all formulations may be classified as Restricted Use Pesticides (RUP). Only certified applicators may purchase and use RUPs. Methyl parathion, EPA toxicity class I, is one of the most toxic organophosphate pesticides (Extoxnet 1996, EPA 1999b). In 1999, EPA accepted the following voluntary cancellation of many of the most significant food crop uses because it has been found to post unacceptable dietary risks to children.

Cancelled Uses	Food Crop
Children's Food	All fruit (apples, peaches, pears, grapes, nectarines, cherries, and plums), carrots, succulent peas, succulent beans, and tomatoes
Other Food	Artichokes, broccoli, Brussels sprouts, cauliflower, celery, collards, kale, kohlrabi, lettuce, mustard greens, rutabagas, spinach, and turnips
Non-Food	Ornamentals, grasses grown for seed, mosquito use and nursery stock
Remaining Uses	Alfalfa, almonds, barley, cabbage, corn, cotton, dried beans, dried peas, grass, hops, lentils, oats, onions, pecans, rape seed (canal), rice, rye, soybeans, sugar beets, sunflower, sweet potato, walnuts, wheat and white potatoes.

Methyl parathion degrades in soil and water over the course of several months primarily by photolysis and biodegradation (Wauchope, *et al*. 1992). The rate of degradation increases with temperature and with exposure to sunlight. The major exception is for spills, where degradation will occur only after many years (Howard 1991). Methyl parathion is moderately adsorbed by most soils and is slightly soluble in water. Methyl parathion metabolizes rapidly in plants and animals and is not expected to bioconcentrate in food products (Howard 1991). Methyl parathion is moderately toxic to fish and to animals that eat fish and highly toxic to aquatic invertebrates such as Daphnia spp., scuds, and sideswimmers (Kidd 1991, US Public Health Service 1995).

3.3 DDT

DDT is probably the best known and most notorious chemical of the century. DDT is an organochlorine insecticide initially used by the military in WWII for the control of mosquitoes,

body lice and fleas responsible for outbreaks of malaria, typhus, and bubonic plague (Ware 2000). It was also used extensively as a broad-spectrum insecticide for the control of almost all agricultural insects and for pest control in buildings (ATSDR 1995, EPA 1980, NPTN 1999,). DDT was used extensively in the 1950s and 1960s for mosquito control in urban areas. "More than 4 billion pounds of DDT have been used throughout the world for insect control since 1940, and 80% of that amount was used in agriculture. Production reached its maximum in the United States in 1961, when 160 million pounds were manufactured." (Ware 2000). DDD is a metabolite of DDT, and was itself manufactured as a pesticide for several years. Because of damage to wildlife and the potential harm to human health, most uses of DDT and all uses of DDD were banned by EPA in December 1972 (EPA 1980). DDE is the major degradation product of DDT and DDD, and is among the most widely occurring pesticide residues (Schmitt *et al*. 1990, Kuehl *et al*. 1994).

DDT is highly persistent in the environment and tissues of plants and animals. The soil half-life for DDT is from 2 to15 years (U.S. Department of Health and Human Services 1994) and the half-life in an aquatic environment is about 150 years (EPA 1979). Because DDT is not readily metabolized, it is stored in the fatty tissues of animals. Biomagnification occurs as animals lower on the food chain are eaten by other animals higher up the food chain (EPA 1975, EPA 1990).

3.4 Toxaphene

Toxaphene was one of the most heavily used insecticides in the United States until 1982, when it was canceled for most uses; all uses were banned in 1990. It was used primarily in the southern United States to control insect pests on cotton and other crops. It was also used to control insect pests on livestock and to kill unwanted fish in lakes (ATSDR 1997). Toxaphene breaks down very slowly in the environment. Because it is not soluble in water, it is more likely to be found in air, soil, or the sediment of lakes or streams than in surface water. Toxaphene is known to bioaccumulate in the tissues of fish and mammals. Therefore, people who eat large quantities of fish and shellfish, which have been contaminated with toxaphene, could be exposed.

4.0 Pesticide Sources

4.1 Nonpoint Sources

Runoff from agricultural and urban areas has been identified as a major nonpoint source of pesticides in surface waters. Because urban land use accounts for less than 1% of the area in the impaired subsegment watersheds, the primary source of pesticides in the surface waters of these subsegments is due to agriculture.

A review of the data shows that seasonal patterns exist for pesticides. Exceedances in the numeric criteria or water quality standards for the pesticides of concern often occurred during the growing season from March through July and often corresponds to the type of crop(s) grown and pesticide used. Similar results were reported for the 1996-98 Mississippi Embayment Study (MISE). In this study, the occurrence and temporal distribution of more than 80 pesticides and their metabolites were determined for five streams including the Tensas River in Louisiana from

1996 to 1998 for a total of 230 stream samples. Distinct seasonal patterns in pesticides were evident in rivers draining agricultural watersheds. These patterns corresponded to the type of crops grown in the basin and the use of pesticides on those crops (Kleiss et al., 2000).

Secondary sources of pesticides in surface waters are from air deposition. Pesticides become airborne during application and when the wind resuspends soil particles to which pesticides are bound. As the soil particles settle from the air, some land on the water surfaces. During times of rainfall, soil particles are washed from the air into the water surface. These soil particles over time settle to the sediments where they remain until disturbed in some way.

Uses of carbofuran in Big Creek, Boeuf River, Joe's Bayou and the Tensas River are from its use on corn, cotton and soybean crops, all of which are primary crops grown in these watersheds. Corn is typically planted from early March through April with cotton being planted from mid April through May. Exceedances in the carbofuran chronic numeric target value (0.13 ug/l) for freshwater aquatic life protection occurred from March through July, which corresponds, to its use on these crops.

Sources of methyl parathion in Big Creek are most likely due to its use on cotton and rice crops. Cotton is one of the primary crops grown in this watershed.

Sources of DDT in Bayou Macon, Big Creek, Boeuf River, Joe's Bayou and the Tensas River are most likely due to soil erosion and attached contaminants and the resuspension of bottom sediments during storm events. Exceedances in the DDT water quality standards occurred in April, May and June 2001. This persistent pesticide, widely used in the Ouachita River Basin for many decades before it was banned from use, will take decades to degrade to a safe level in the environment.

Sources of toxaphene in the Tensas River and Boeuf River are most likely due to residues remaining in the soils and bottom sediments from decades of use. Toxaphene degrades very slowly and therefore, could take decades to degrade to a level below which human health would not be affected.

4.2 Point Sources

There are no known point sources for a carbofuran, DDT, methyl parathion or toxaphene in Big Creek, Boeuf River, Joe's Bayou, Macon Bayou or the Tensas River watersheds; therefore, the WLA will be set to zero.

5.0 TMDL Load Calculations

Pesticide loads have been calculated using the appropriate chronic numeric target or water quality standard and stream flow. The following equation can be used to calculate a pesticide load.

Equation 1: C x 0.001 x Q in cfs x 5.39 or C x 0.001 x Q in MGD x 8.34

Where: C = concentration in mg/L
Q = stream flow in cfs or MGD

A traditional expression of pesticide loading may be developed by setting one critical or representative flow and concentration, and calculating the pesticide loading using Equation 1. For the purpose of calculating the critical pesticide loading for these subsegments, the chronic pesticide numeric target or water quality standard for freshwater was used as the concentration in conjunction with the critical flow (daily average seasonal flow occurring from March through July) at the lower portion of each subsegment (Table 2). Using these values and Equation 1, the TMDL load was calculated for the March-July growing season for each subsegment and pesticide (See Section 6.0 for individual calculations).

6.0 TMDL

6.1 Bayou Macon

6.11 Land Use

Bayou Macon is located within segment 0810 of the Ouachita River Basin in northeastern Louisiana. Bayou Macon flows generally in a southerly direction from the Arkansas state line to the Tensas River. Land cover in subsegment 081001 is predominately row crops (65.9%), small grains (12.8%) and pasture/hay (5.4%). Major land uses are listed in Table 3.

Table 3. Land Use (km^2) in the Bayou Macon watershed.

Cover Type	Area ($km^{2)}$	Percent of Watershed
Row Crops	604.19	65.9
Small Grains	116.99	12.8
Mixed Forest	53.43	5.8
Pasture/Hay	49.86	5.4
Woody Wetlands	45.38	4.9
Deciduous Forest	17.47	1.9
Open water	15.30	1.7
Evergreen Forest	8.48	0.9
Urban	5.10	0.6
Other	1.15	0.1
Emergent Herbaceous Wetlands	0.04	0.0
Total	917.38	100.0

6.12 Flow

Flow is a critical element in establishing a TMDL. Point sources usually have a defined critical receiving stream low flow such as the 7Q10 at which the criterion must be met. For nonpoint sources due to pesticides, the critical flow period is defined as the application season from March through July. It was assumed that the most common method of pesticides entering

surface waters would be from wet weather flows where pesticides may be carried from plants and or soils via an overland route to adjacent stream segments. For this reason a mean flow value was used in this TMDL. The mean flow represents 66.2% of the flow values.

USGS daily stream flows were retrieved for the gage at Bayou Macon near Delhi, LA. Basic information and seasonal summary statistics for this gage are summarized in Table 6. Data for the period of record (Oct 1935- Sep 1998) for the growing season (Mar-Jul) from this gage were used for calculating the descriptive statistics. First, the flow per square mile for the gage station drainage area was calculated by dividing the statistic of interest (mean, min, max, etc.) by the gage drainage area. Then, the calculated flow per square mile for the statistic of interest was multiplied by the drainage area of the Bayou Macon watershed. Joe's Bayou is included in the Bayou Macon watershed because it is a major tributary. For Bayou Macon, the daily average seasonal flow is calculated as follows: (1.158 cfs/782 mi^2) X 450 mi^2 = 666 cfs.

6.13 TMDL Load Allocation (LA)

The load allocation for DDT for a given flow in Bayou Macon can be calculated using Equation 1 and the following relationship:

(TMDL @ given flow and appropriate water quality standard) – (WLA) – MOS = LA

The LA for DDT is the TMDL (0.0035 lbs/day) minus the WLA (0) minus a 20% margin of safety (MOS) (0.0007 lbs/day). (See Table 4).

In addition to the Bayou Macon load, no introduction of DDT, which causes localized concentrations to be greater than the water quality standard (0.0019 ug/l) will be authorized. EPA banned the use of DDT in 1972, thus no new additions of DDT are being introduced into the environment.

Table 4. TMDL load (lbs/day) for selected pesticides in Bayou Macon.

Daily Avg. Seasonal Flow (cfs)	Pesticide	Conc. (ug/l)	Load Allocation (lbs/day)	MOS 20% (lbs/day)	TMDL (lbs/day)
666	DDT	0.0019[a]	0.0056	0.0014	0.007

a = LDEQ water quality standard for the protection of human health in a non-drinking water supply

6.14 Wasteload Allocation (WLA)

There are no known point sources for DDT on Bayou Macon; therefore, the WLA is set to zero.

6.2 Joe's Bayou

6.21 Land Use

Joe's Bayou is located within segment 0810 of the Ouachita River Basin. Joe's Bayou flows generally in a southerly direction from its headwaters to its confluence with Bayou Macon. Land use in subsegment 081002 is predominately agriculture (91%) with row crops accounting for 56.6% of the area followed by small grains (25.2%). The major land uses are listed in Table 5.

Table 5. Land use (km^2) in the Joe's Bayou watershed.

Cover Type	Area ($km^{2)}$	Percent of Watershed
Row Crops	140.02	56.6
Small Grains	62.30	25.2
Pasture/Hay	22.81	9.2
Mixed Forest	7.46	3.0
Evergreen Forest	5.08	2.1
Open water	4.73	1.9
Woody Wetlands	2.64	1.1
Deciduous Forest	2.15	0.9
Urban	0.14	0.1
Other	0.09	0.0
Emergent Herbaceous Wetlands	0.02	0.0
Total	247.44	100.0

6.22 Flow

Flow is a critical element in establishing a TMDL. Point sources usually have a defined critical receiving stream low flow such as the 7Q10 at which the criterion must be met. For nonpoint sources due to pesticides, the critical flow period is defined as the growing season from March through July. It was assumed that the most common method of pesticides entering surface waters would be from wet weather flows where pesticides may be carried from plants and or soils via an overland route to adjacent stream segments. For this reason a mean flow value was used in this TMDL. The mean flow represents 66.2% of the flow values.

The nearest USGS gage station is located in Bayou Macon. Daily stream flows were retrieved for the gage at Bayou Macon near Delhi, LA. Basic information and seasonal summary statistics for this gage and the calculated seasonal flows for Joe's Bayou are summarized in Table 6. Data for the period of record (Oct 1935 – Sep 1998) for the growing season (Mar-Jul) from this gage was used for calculating the descriptive statistics. First, the flow per square mile for the gage station drainage area was calculated by dividing the statistic of interest (mean, min, max, etc.) by the gage drainage area. Then, the calculated flow per square mile for the statistic of interest was multiplied by the drainage area of the Joe's Bayou watershed. For Joe's Bayou, the daily average seasonal flow is calculated as follows: (1,158 cfs/782 mi^2) X 450 mi^2 = 142 cfs.

Table 6. Information for USGS stream flow gage station (07370000) and calculated seasonal flow data for Bayou Macon and Joe's Bayou

	Actual Daily Seasonal Flow USGS gage	Calculated Daily Seasonal Flow Bayou Macon	Calculated Daily Seasonal Flow Joe' Bayou
Subsegment		081001	081002
USGS gage number	07370000		
Hydrologic Unit Code	08050002	08050002	08050002
Descriptive location	Latitude 32°27'25", Longitude 91°28'30" NAD27	Latitude 31.98218481 Longitude 91.56554688	Latitude 32.38942114 Longitude 91.87917
Drainage area	782 mi^2	450 mi^{2*}	96mi2
Period of record	10/1/1935 – 9/30/1998	10/1/1935 – 9/30/1998	10/1/1935 – 9/30/1998
Period of Interest	Mar – July (growing season)	Mar – July (growing season)	Mar – July (growing season)
Mean seasonal flow	1,158 cfs	666 cfs	142 cfs
Minimum seasonal flow	0 cfs	0 cfs	0 cfs
Maximum seasonal flow	11,900 cfs	6,848 cfs	1,461 cfs
Flow that is exceeded:			
80% of the time	1,940 cfs	1,116 cfs	238 cfs
50% of the time	623 cfs	358 cfs	76 cfs
20% of the time	210 cfs	121 cfs	26 cfs

*For calculating the seasonal flow in Bayou Macon, the drainage area for Bayou Macon (354 mi2) and Joe's Bayou (96mi2) were combined because Joe's Bayou is a major tributary to Bayou Macon.

6.23 TMDL

The load allocation for carbofuran and DDT for a given flow in Joe's Bayou can be calculated using Equation 1 and the following relationship:

(TMDL @ given flow and appropriate water quality standard or numeric target) – (WLA) – MOS = LA

The LA for carbofuran is the TMDL(0.10 lbs/day) minus the WLA (0) minus a 20% MOS (0.02 lbs/day). The LA for DDT is the TMDL (0.001 lbs/day) minus the WLA (0) minus a 20% MOS (0.0001 lbs/day). (See Table 7).

In addition to the Joe's Bayou loads, no introduction of carbofuran or DDT which causes localized concentrations to be greater than the numeric target or water quality standard (0.13 ug/l and 0.0019 ug/l, respectively) will be authorized. EPA banned the use of DDT in 1972, thus no new additions of DDT are being introduced into the environment.

Table 7. TMDL load (lbs/day) for selected pesticides in Joe's Bayou.

Daily Avg. Seasonal Flow (cfs)	Pesticide	Conc. (ug/l)	Load Allocation (lbs/day)	MOS 20% (lbs/day)	TMDL (lbs/day)
142	carbofuran	0.13[a]	0.08	0.02	0.10
142	DDT	0.0019[b]	0.0009	0.0001	0.001

a = numeric target, b = LDEQ water quality standard for the protection of human health in a non-drinking water supply

6.24 Wasteload Allocation (WLA)

There are no known point sources carbofuran and DDT on Joe's Bayou; therefore, the WLA is set to zero.

6.3 Boeuf River

6.31 Land Use

Boeuf River is located within segment 0809 of the Ouachita River Basin in north central Louisiana. The Boeuf River flows generally in a southerly direction from the Arkansas State Line to its confluence with the Ouachita River. Land use in subsegment 080901 is predominately agriculture (74.6%) with row crops accounting for 60.1% of the area. The major land uses are listed in Table 8.

6.32 Flow

Flow is a critical element in establishing a TMDL. Point sources usually have a defined critical receiving stream low flow such as the 7Q10 at which the criterion must be met. For nonpoint sources due to pesticides, the critical flow period is defined as the growing season from March through July. It was assumed that the most common method of pesticides entering surface waters would be from wet weather flows where pesticides may be carried from plants and or soils via an overland route to adjacent stream segments. For this reason a mean flow value was used in this TMDL. The mean flow represents 73.2% of the flow values.

Table 8. Land use (km^2) in the Boeuf River watershed.

Cover Type	Area ($km^{2)}$	Percent of Watershed
Row Crops	986.90	60.1
Woody Wetlands	259.33	15.8
Small Grains	158.38	9.6
Pasture/Hay	80.79	4.9
Mixed Forest	69.76	4.2
Open water	41.49	2.5
Deciduous Forest	29.38	1.8
Evergreen Forest	10.45	0.6
Urban	3.13	0.2
Emergent Herbaceous Wetlands	1.71	0.1
Other	1.30	0.1
Total	1642.62	100.0

USGS daily stream flows were retrieved for the gage at the Boeuf River near Girard, LA. Basic information and seasonal summary statistics for this gage and the calculated seasonal flows for the Boeuf River are summarized in Table 11. Data for the period of record (Oct 1938 – Sep 1998) for the growing season (Mar-Jul) from this gage were used for calculating the descriptive statistics. First, the flow per square mile for the gage station drainage area was calculated by dividing the statistic of interest (mean, min, max, etc.) by the gage drainage area.

Then, the calculated flow per square mile for the statistic of interest was multiplied by the drainage area of the Boeuf River watershed. Big Creek is included in the Boeuf River watershed because it is a major tributary. For the Boeuf River, the daily average seasonal flow is calculated as follows: (355 cfs/1,226 mi^2) X 1,067 mi^2 = 309 cfs.

6.33 TMDL Load Allocation

The load allocation for carbofuran, DDT and toxaphene for a given flow in the Boeuf River can be calculated using Equation 1 and the following relationship:

(TMDL @ given flow and appropriate water quality standard or numeric target) – (WLA) – MOS = LA

The LA for carbofuran is the TMDL (0.22 lbs/day) minus the WLA (0) minus a 20% MOS (0.044 lbs/day). The LA for DDT is the TMDL (0.003 lbs/day) minus the WLA (0) minus a 20% MOS (0.0006 lbs/day). The LA for toxaphene is the TMDL (0.0004 lbs/day) minus the WLA (0) minus a 20% MOS (0.00008 lbs/day). (See Table 9).

In addition to the subsegment specific loads, no introduction of carbofuran, DDT or toxaphene, which causes localized concentrations to be greater than the numeric target or water quality standard (0.13 ug/l, 0.0019, and 0.00024 ug/l, respectively) will be authorized. EPA banned the use of DDT in 1972 and toxaphene in 1990, so no new additions of DDT or toxaphene are being introduced into the environment.

Table 9. TMDL load (lbs/day) for selected pesticides in the Boeuf River.

Daily Avg. Seasonal Flow (cfs)	Pesticide	Conc. (ug/l)	Load Allocation (lbs/day)	MOS 20% (lbs/day)	TMDL (lbs/day)
309	carbofuran	0.13[a]	0.176	0.044	0.22
309	DDT	0.0019[b]	0.0024	0.0006	0.003
309	Toxaphene	0.00024[b]	0.00032	0.00008	0.0004

a = numeric target, b = LDEQ water quality standard for the protection of human health in a non-drinking water supply

6.34 Wasteload Allocation (WLA)

There are no known point sources for carbofuran, DDTor toxaphene for the Boeuf River; therefore, the WLA is set to zero.

6.4 Big Creek

6.41 Land Use

Big Creek is located within segment 0809 of the Ouachita River Basin in north central Louisiana. Big Creek flows generally in a southerly direction from its headwaters to its confluence with the Boeuf River. Land use in subsegment 080903 is predominately agriculture

(79.4%) with row crops accounting for 70.1% of the area. The major land uses are listed in Table 10.

Table 10. Land Use (km^2) in the Big Creek watershed.

Cover Type	Area ($km^{2)}$	Percent of Watershed
Row Crops	784.55	70.1
Mixed Forest	123.11	11.0
Small Grains	91.06	8.1
Woody Wetlands	62.15	5.6
Deciduous Forest	15.97	1.4
Pasture/Hay	13.67	1.2
Urban	10.06	0.9
Open water	9.07	0.8
Evergreen Forest	8.62	0.8
Other	0.14	0.0
Total	1118.40	100.0

6.42 Flow

Flow is a critical element in establishing a TMDL. Point sources usually have a defined critical receiving stream low flow such as the 7Q10 at which the criterion must be met. For nonpoint sources due to pesticides, the critical flow period is defined as the growing season from March through July. It was assumed that the most common method of pesticides entering surface waters would be from wet weather flows where pesticides may be carried from plants and or soils via an overland route to adjacent stream segments. For this reason a mean flow value was used in this TMDL. The flow represents 73.2% of the flow values.

The nearest USGS gage station is located in the Boeuf River. Daily stream flows were retrieved for the gage at Boeuf River near Girard, LA. Basic information and seasonal summary statistics for this gage and the calculated seasonal flows for Big Creek are summarized in Table 11. Data for the period of record (Oct 1938 – Sep 1998) for the growing season (Mar-Jul) from this gage were used for calculating the descriptive statistics. First, the flow per square mile for the gage station drainage area was calculated by dividing the statistic of interest (mean, min, max, etc.) by the gage drainage area. Then, the calculated flow per square mile for the statistic of interest was multiplied by the drainage area of the Big Creek watershed. For Big Creek, the daily average seasonal flow is calculated as follows: (355 cfs/1,226 mi^2) X 432 mi^2 = 125 cfs.

6.43 TMDL Load Allocation

The load allocation for carbofuran, DT and methyl parathion for a given flow in Big Creek be calculated using Equation 1 and the following relationship:

(TMDL @ given flow and appropriate water quality standard or numeric target) – (WLA) – MOS = LA

The LA for carbofuran is the TMDL (0.09 lbs/day) minus the WLA (0) minus a 20% MOS (0.0018 lbs/day). The LA for DDT is the TMDL (0.001 lbs/day) minus the WLA (0) minus a 20% MOS (0.0001 lbs/day). The LA for methyl parathion is the TMDL (0.11 lbs/day) minus the WLA (0) minus a 20% MOS (0.0001). (See Table 12).

In addition to the Big Creek loads, no introduction of DDT, carbofuran, or methyl parathion which causes localized concentrations to be greater than the appropriate water quality standard or numeric target (0.0019 ug/l, 0.13 ug/l and 0.17 ug/l respectively) will be authorized. EPA banned the use of DDT in 1972, thus no new additions of DDT are being introduced into the environment.

Table 11. Information for USGS stream flow gage station (07368000) and calculated seasonal flow data for Boeuf River and Big Creek.

	Actual Daily Seasonal Flow USGS gage	Calculated Daily Seasonal Flow Boeuf River	Calculated Daily Seasonal Flow Big Creek
Subsegment		080901	080903
USGS gage number	07368000		
Hydrologic Unit Code	08050001	08050001	08050001
Descriptive location	Latitude 32°28'52", Longitude 91°47'52" NAD27	Latitude 31.88928 Longitude 91.78881	Latitude 32.20522087 Longitude 91.8201761
Drainage area	1,226 mi^2	1067 mi^{2*}	432 mi^2
Period of record	10/1/1938 – 9/30/1998	10/1/1938 – 9/30/1998	10/1/1938 – 9/30/1998
Period of Interest	Mar – July (growing season)	Mar – July (growing season)	Mar – July (growing season)
Mean flow	355 cfs	309 cfs	125 cfs
Minimum flow	0 cfs	0 cfs	0 cfs
Maximum flow	2,980 cfs	2,594 cfs	1,050 cfs
Flow that is exceeded:			
80% of the time	581 cfs	506 cfs	205 cfs
50% of the time	113 cfs	98 cfs	40 cfs
20% of the time	30 cfs	26 cfs	11 cfs

*For calculating the seasonal flow in Boeuf River, the drainage area for Boeuf River (635 mi2) and Big Creek (432mi2) were combined because Big Creek is a major tributary to the Boeuf River.

Table 12. TMDL load (lbs/day) for selected pesticides in Big Creek.

Daily Avg. Seasonal Flow (cfs)	Pesticide	Conc. (ug/l)	Load Allocation (lbs/day)	MOS 20% (lbs/day)	TMDL (lbs/day)
125	carbofuran	0.13[b]	0.072	0.018	0.09
125	DDT	0.0019[c]	0.0009	0.0001	0.001
125	methyl parathion	0.17[b]	0.088	0.022	0.11

a = proposed national water quality standard, b = numeric target, c = LDEQ water quality standard for the protection of human health in a non-drinking water supply

6.44 Wasteload Allocation (WLA)

There are no known point sources for carbofuran, DDT or methyl parathion for Big Creek; therefore, the WLA is set to zero.

6.5 Tensas River

6.51 Land Use

The Tensas River Basin is located within segment 0812 of the Ouachita River Basin in northeastern Louisiana. It flows generally in a southern direction for 165 miles from its headwaters in Lake Providence to Jonesville, where it joins the Ouachita and Little Rivers to form the Black River (Coupe 2000). Due to its meandering pattern, the Tensas River is believed to be an abandoned course of the Mississippi River (USACE, 1974). Land use in subsegment 081201 is predominately agriculture (72.3%) with row crops accounting for 62.5% of the area. Secondary to row crops, forested wetlands occupy 22.7% of the basin and is one of the largest remaining tracts of forested wetlands in the Mississippi Valley (Gosselink and others, 1990). The major land uses are listed in Table 13.

Table 13. Land use (km^2) in the Tensas River watershed.

Cover Type	Area ($km^{2)}$	Percent of Watershed
Row Crops	1946.49	62.5
Woody Wetlands	707.15	22.7
Small Grains	166.44	5.3
Pasture/Hay	141.03	4.5
Open water	42.24	1.4
Mixed Forest	25.32	0.8
Emergent Herbaceous Wetlands	25.15	0.8
Deciduous Forest	24.98	0.8
Urban	15.90	0.5
Evergreen Forest	12.21	0.4
Other	8.07	0.3
Bare Rock/Sand/Clay	0.42	0.0
Total	3115.39	100.0

6.52 Flow

Flow is a critical element in establishing a TMDL. Point sources usually have a defined critical receiving stream low flow such as the 7Q10 at which the criterion must be met. For nonpoint sources due to pesticides, the critical flow period is defined as the growing season from March through July. It was assumed that the most common method of pesticides entering surface waters would be from wet weather flows where pesticides may be carried from plants and or soils via an overland route to adjacent stream segments. For this reason a mean flow value was used in this TMDL. The flow represents 70% of the flow values.

USGS daily stream flows were retrieved for the gage at the Tensas River at Tendal, LA. Basic information and summary statistics for this gage are summarized in Table 14. Data for the period of record (Apr 1936 – Sep 1998) or the growing season (Mar-Jul) from this gage were

used for calculating the descriptive statistics in the table above. First, the flow per square mile for the gage station drainage area was calculated by dividing the statistic of interest (mean, min, max, etc.) by the gage drainage area. Then, the calculated flow per square mile for the statistic of interest was multiplied by the drainage area of the Tensas watershed. For the Tensas River, the daily average seasonal flow is calculated as follows: (418 cfs/309 mi^2) X 1,203 mi^2 = 1,627 cfs.

6.53 TMDL Load Allocation

The load allocation for carbofuran, DDT and toxaphene for a given flow in the Tensas River can be calculated using Equation 1 and the following relationship:

(TMDL @ given flow and appropriate water quality standard or numeric target) – (WLA) – MOS = LA

Table 14. Information for USGS stream flow gage station (07369500) and calculated seasonal flow data for the Tensas River.

	Actual Daily Seasonal Flow USGS gage	Calculated Daily Seasonal Flow Tensas River
Subsegment		081201
USGS gage number	07369500	
Hydrologic Unit Code	08050003	08050003
Descriptive location	Latitude 32°25'55" Longitude 91°22'00" NAD27	Latitude 31.63344 Longitude 91.80194
Drainage area	309 mi^2	1,203 mi^2
Period of record	4/1/1936 – 9/30/1998	4/1/1936 – 9/30/1998
Period of Interest	Mar – July (growing season)	Mar – July (growing season)
Mean flow	418 cfs	1,627 cfs
Minimum flow	4 cfs	16 cfs
Maximum flow	3,970 cfs	15,456 cfs
Flow that is exceeded: 80% of the time 50% of the time 20% of the time	 690 cfs 141 cfs 40 cfs	 2,686 cfs 549 cfs 156 cfs

The LA for carbofuran is the TMDL (1.14 lbs/day) minus the WLA (0) minus a 20% MOS (0.228 lbs/day). The LA for DDT is the TMDL (0.017 lbs/day) minus the WLA (0) minus a 20% MOS (0.0034 lbs/day). The LA for toxaphene is the TMDL (0.002 lbs/day) minus the WLA (0) minus a 20% MOS (0.0004). (See Table 15).

In addition to the Tensas River loads, no introduction of carbofuran, DDT or toxaphene, which causes localized concentrations to be greater than the numeric target or water quality standard (0.13 ug/l, and 0.0019 ug/l and 0.00024 ug/l, respectively) will be authorized. EPA banned the use of DDT in 1972 and toxaphene in 1990, so no new additions of DDT or toxaphene are being introduced into the environment.

Table 15. TMDL load (lbs/day) for selected pesticides in the Tensas River.

Daily Avg. Seasonal Flow (cfs)	Pesticide	Conc. (ug/l)	Load Allocation (lbs/day)	MOS 20% (lbs/day)	TMDL (lbs/day)
1,627	carbofuran	0.13[a]	0.912	0.228	1.14
1,627	DDT	0.0019[b]	0.0136	0.0034	0.017
1,627	Toxaphene	0.00024[b]	0.0016	0.0004	0.002

a = numeric target, b = LDEQ water quality standard for the protection of human health in a non-drinking water supply

6.54 Wasteload Allocation (WLA)

There are no known point sources for carbofuran, DDT or toxaphene on the Tensas River; therefore, the WLA is set to zero.

7.0 Seasonal Variation

Section 303(d)(1) requires that all TMDLs be "established at a level necessary to implement the applicable water quality standard with seasonal variations. A review of the data shows that, in general, values greater than the numeric target or water quality standard for freshwater are more likely to occur in the months of March through July, all of which fall within the growing season. Kleiss, *et al*. (2000) reported in the MISE study that seasonal patterns correspond to the type of crops grown in a basin and the use of pesticides on those crops. Similar patterns were observed during the review of data from LDAF, NAWQA, and the EPA study. Therefore, the growing season from March through July is identified as the critical period. Development of flow values indexed to this period satisfies the consideration of seasonal variation.

8.0 Margin of Safety

The CWA requires that each TMDL be established with a margin of safety (MOS). This requirement for a MOS is intended to account for uncertainty in available data or in the actual effect controls will have on the loading reductions and receiving water quality. A MOS may be expressed explicitly as unallocated assimilative capacity or implicitly through conservative analytical assumptions used in establishing the TMDL. The MOS is not intended to compensate for failure to consider known sources. An explicit MOS of 20% was used for all loads for uncertainty and data inadequacies.

9.0 Reasonable Assurance and Other Relevant Information

The goal of this TMDL is to reduce pesticide (carbofuran, DDT, methyl parathion, and toxaphene) concentrations in the impaired subsegments of the Ouachita River Basin to meet the water quality objectives for toxicity and pesticides in these watersheds. Attainment of these targets and allocations are expected to result in attainment of the narrative objectives for toxicity and pesticides, and, hence, protect the freshwater habitat and wildlife habitat beneficial uses in this watershed and in the case of DDT and toxaphene, indirectly protect human health.

Reductions in surface water loads of these pesticides will be achieved through application controls and other BMPs designed to reduce the transport of pesticides to surface waters. For example, liquid or powdered formulations of carbofuran are classified as Restricted Use Pesticides (RUP) because of their acute oral and inhalation toxicity to humans. LDAF reports that liquid formulations of carbofuran are used in cotton, corn, soybean and wheat production with prior approval from LDAF. These are the only current uses of carbofuran in Louisiana.

As previously discussed the source of DDT and toxaphene in these basins was from historic applications to agricultural crops for the control of insects. Because of their past heavy and widespread use, strong affinities for sorption to sediment organic matter and tissue, and slow rates of decomposition, DDT and toxaphene and/or their degradation products frequently remain at elevated levels in the environment for many years after widespread use has ended (Smith et al. 1988). Bans on the use of DDT and toxaphene have resulted in a slow but steady decline in environmental residues (Smith et al., 1988). Continuing decreases in the environmental levels of these pesticides is expected via degradation and metabolism of the contaminants and burial of contaminated sediment through natural sedimentation. This is the preferred mechanism for removal of these pesticides from the environment. Alternative approaches primarily reserved for heavily contaminated sites due to point source discharges and major spills include removal of contaminated sediments by dredging and eradication of contaminated fish communities and restocking. Removal of contaminated sediments results in habitat disturbance and destruction. Resuspension of contaminated sediments during dredging further exposes aquatic life to the contaminants increasing the potential for additional uptake. Increased turbidity from resuspended sediments damages the gills and sensory organs of fish and invertebrates and interferes with fish prey selection (O'Brien 1990, Waters 1995).

Because of the limited amount of data to support the 1999 Court Ordered Listing for subsegments impaired due to pesticides in the Ouachita River Basin, additional data will be collected quarterly through LDAF's ambient monitoring program during the next three years. The data will be analyzed to determine if the TMDL has resulted in attainment of the appropriate water quality standards or numeric targets for freshwater or needs some adjustment to bring the impaired subsegment(s) in the Ouachita River Basin into attainment.

9.1 Fish Advisories

Health advisories identify which activities or fish consumption levels pose a health risk to the public and attempt to advise the public regarding fish and shellfish consumption and recreational water activities that may adversely affect public health. "LDEQ currently issues fish consumption and swimming advisories in conjunction with the Louisiana Department of Health and Hospitals (LDHH). The Louisiana Department of Wildlife and Fisheries (LDWF), and the Louisiana Department of Agriculture and Forestry (LDAF) are also consulted during the course of advisory development and dissemination. Fish consumption advisories are set using a risk assessment based method, which establishes consumption levels designed to prevent adverse effects on public health. Risk assessments are used to determine safe consumption levels for different segments of the population. For example, children and pregnant or lactating women are often considered separately in developing risk assessments because this population is generally considered to be at greater risk from consumption of contaminated seafood. Therefore, limited

consumption advisories will often be stricter for this population. If its determined there is a need for a health advisory press releases will be prepared for public dissemination of the information. Advisories are also published in LDWF's annual fishing regulations." (LDEQ 2000).

The endpoint target for DDT and toxaphene in fish advisories is the reduction of fish tissue contaminant concentration to levels that constitute an acceptable risk to fish consumers, allowing LDHH to remove the ban on fish consumption in the Tensas River. According to LDEQ (1998), "the Office of Water Resources (OWR) does not maintain a regular fish tissue monitoring program. However, fish are frequently sampled in response to significant complaints, as a result of enforcement action, or in response to other problems as they occur." The fish advisory for the Tensas River has been in effect since February 1992 without further review. Because DDT and toxaphene are known to accumulate in the sediments and tissues of fish, it is recommended that both sediment and fish tissue samples be collected from the Tensas and Boeuf Rivers over the next three years to determine if the fish consumption advisory on the Tensas River initiated in February 1992 is still necessary and if additional fish advisories need to be established for DDT and toxaphene for the Boeuf River.

9.2 Regulatory Authority

LDAF is the lead agency for pesticide regulatory control in Louisiana. The jurisdiction and authority of LDAF relative to pesticide matters is set out in the Louisiana Pesticide Law (Title 3 of the Louisiana Revised Statutes). Under the state regulatory system, the commissioner has the authority to adopt rules and regulations necessary to implement the provisions under this law including but not limited to rules and regulations governing the registration, distribution, sale, offering for sale, and application of pesticides. Furthermore, the commissioner has the authority to establish emergency procedures involving imminent danger to human health or the environment.

Under the Louisiana Pesticide Law, each pesticide, which is sold, offered for sale, or distributed in Louisiana, is registered annually. Proper certification is required to apply or supervise the application of any restricted use pesticide as a private applicator. Proper licensing is required for individuals who own or operate a business engaged in the applications of pesticides for a fee. A key component of enforcement is that it is illegal to make a pesticide recommendation or application inconsistent with the labeling or in violation of the EPA or state restriction on the use of that pesticide.

It is the responsibility of the commissioner to determine when the concentrations of pesticide wastes exceed promulgated federal or state standards, or when the concentrations of pesticides pose a threat or reasonable expectation of a threat to human health or to the environment. When such determinations are made, the commissioner shall decide the appropriate action to be taken.

LDAF monitors quarterly for the presence of pesticides in the waters of Louisiana. Determinations of excessive levels are based on scientific and technical information. Investigations may be conducted to facilitate such determinations. Excessive pesticide

concentrations are alleviated through minimizing, mitigating, and preventing the potential for excessive levels. If necessary, appropriate enforcement actions may taken.

10.0 Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comments concerning the TMDL. EPA prepared this TMDL pursuant to the consent decree, Sierra Club, et al. v. Clifford et al., No. 96-0527, (E.D. La.) signed and entered on April 1, 2002. Federal regulation requires that public notice be provided through the Federal Register and through newspapers in the local area. The Federal Register notice was issued on March 29, 2002 (Volume 67, Number 61, pages 15196 – 15198). This TMDL was also noticed in local newspapers including *The Times-Picayune* (New Orleans- statewide) and *Lake Charles American Press*. Comments and additional information were submitted during the 30-day public comment period. Response to comments were made available in Appendix F of the March 2002 TMDL. EPA provided notice the March 2002 TMDL was made final, to the court, and to the Louisiana Department of Environmental Quality (LDEQ) and notification that it be incorporated into LDEQ's current water quality management plan.

On January 14, 2003, EPA noticed in the Federal Register (Vol.68, No.9) its withdrawal of the March 2002 TMDL for atrazine in the water column that EPA established pursuant to the Clean Water Act section 303(d), for Louisiana subsegment 080903, Big Creek from the confluence with the Boeuf River to the headwaters (including Big Colewa Bayou). EPA withdrew this TMDL because the draft criteria value for atrazine used in screening the waterbody to determine whether it meets Louisiana water quality standards and for calculation of allowable load allocations was draft only and had not been through the complete public notice process and had not been finalized. In place of the draft atrazine criteria number of 12 ug/l, EPA is established a screening value of 36 ug/l as calculated by one possible procedure found in Louisiana water quality standards (LAC 33:IX,1113.C.6.). Based on this new screening value of 36 ug/l, Big Creek is not, and was not at the time EPA established this TMDL, impaired by atrazine and should not have been listed on Louisiana's 1993 3039d) list for atrazine. Therefore, this TMDL has been revised to reflect the above information and replaces the final TMDL dated March 2002.

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APPENDIX A: Recommended Freshwater Aquatic Life Protection Numeric Targets for Pesticides in Louisiana TMDL Development

CAS #	Name	Conc. (ug/l) LC50	Acute Numeric Level (ug/l)	Chronic Numeric Level (ug/l)	Species
94757	2,4-D	6,539	654	327	*Micropterus dolomieui*
15972608	Alachlor		760	76	EPA Recommended Criteria
101053	Anilazine	3	0.3	0.15	*Ceriodaphnia dubia*
1912249	Atrazine		72.0	36.0	
28249776	Benthiocarb	510	51	25.5	*Ceriodaphnia dubia*
314409	Bromacil	186,000	18,600	9,300	*Pimephales promelas*
1563662	Carbofuran	2.6	0.26	0.13	*Ceriodaphnia dubia*
81777891	Clomazone	34,000	3,400	1,700	*Lepomis macrochirus*
21725462	Cyanazine	12,693	1,269	635	*Ictalurus punctatus*
333415	Diazinon		0.1	0.1	Draft EPA Recommended Criteria
99309	Dichloran	1.08	0.11	0.055	*Lepomis macrochirus*
55290647	Dimethipin	20,900	2,090	1,045	Daphnia sp.
120068373	Fipronil	45.6	4.6	2.3	*Lepomis macrochirus*
2164172	Fluometuron	3,157	316	158	*Ameiurus melas*
51218452	Metolachlor		390	100	EPA Recommended Criteria
298000	Methyl Parathion	3.4	0.34	0.17	Southern House Mosquito
21087649	Metribuzin		N/A	100	EPA Recommended Criteria
2212671	Molinate	327	32.7	16.35	*Lepomis macrochirus*
27314132	Norflurazon	16,300	1,630	815	*Lepomis macrochirus*
19666309	Oxidiazon	2,400	240	120	*Daphnia magna*
40487421	Pendimethalin	280	28	14	*Ceriodaphnia dubia*
7287196	Prometryne	10,000	1,000	500	*Lepomis macrochirus*
709988	Propanil	1,540	154	77	*Ceriodaphnia dubia*
60207901	Propiconazole	2,925	292	146	*Lepomis macrochirus*
5902512	Terbacil	33,948	3,395	1,697	*Lepomis macrochirus*
59669260	Thiodicarb	27	2.7	1.35	*Daphnia magna*
55335063	Tricorpyr	4,243	424.3	212	Mayfly
1582098	Trifluralin	32.3	3.23	1.62	*Lepomis macrochirus*

LC_{50} values used – 48 hour for invertebrates and 96 hour for vertebrates

APPENDIX B-1: State of Louisiana Water Quality Standards for toxics and supporting documentation submitted to EPA Region 6

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF WATER RESOURCES
WATER POLLUTION CONTROL DIVISION
JUNE, 1989

DOCUMENTATION OF NUMERICAL CRITERIA FOR ACUTE AND CHRONIC AQUATIC LIFE PROTECTION IN THE 1989 WATER QUALITY STANDARDS REVISION

Numerical criteria for fresh water and marine water aquatic life protection as listed in Table 1 of the proposed 1989 Water Quality Standards revision were derived from criteria documents of the Environmental Protection Agency. Aquatic life criteria for the following toxic substances were taken directly from those recommended in the EPA document Quality Criteria for Water 1986:

1. Aldrin
2. Chlordane
3. DDT
6. Dieldrin
7. Endosulfan
8. Endrin
9. Heptachlor
10. Hexachlorocyclohexane (gamma BHC, Lindane)
11. Polychlorinated Biphenyls, Total (PCB's)
12. Toxaphene
13. 2, 4-Dichlorophenoxyacetic acid (2, 4-D)
14. 2-(2, 4, 5-Trichlorophenoxy) propionic acid (2, 4, 5-TP, Silvex)
46. Arsenic
47. Chromium III (Tri) - Freshwater Acute and Chronic only
48. Chromium VI (Hex)
49. Zinc

Numerical criteria for aquatic life protection for the remaining toxic substances were not directly available from EPA and were derived from LC50 data for each toxic substance as presented in the following EPA documents; (1) Ambient Water Quality Criteria, 1980. EPA Series 440/5-80 and (2) Ambient Water Quality Criteria. 1984. EPA Series 440/5-84-85. To derive a criterion value, an application factor was multiplied by the lowest reported LC50 value for a representative Louisiana species as listed in Table 1 of the EPA criteria documents. Appliction factors used were those recommanded in the EPA Water Quality Criteria 1972 (p. 123) and Quality Criteria for Water 1976 (p. 2, 3). This approach was developed in cooperation with Region VI EPA. For nonpersistent or noncumulative toxic substances, an application factor of 0.1 was used for acute protection and 0.05 was used for chronic protection. For persistent or cumulative toxic substances, an application factor of 0.05 was used for acute protection and 0.01 was used for chronic protection. The use of application factors provides a safety consideration to protect all life stages of a test species as well as to protect associated species that have not been tested and may be more sensitive to the tested toxic substance.

The following is a listing of the lowest reported LC50 values and representative Louisiana species utilized to derive numerical criteria.

Toxic Substance	Class [1]	Species [2]	LC50 [3]
4. TDE (DDD)	P	Scud	0.6
		Oyster	25
5. DDE	P	Planarian	1,050
		Oyster	14
15. Benzene	NP	Bluegill [4]	22,490
		P. pugio	27,000
16. Carbon Tetrachloride	NP	Bluegill	27,300
		T. Silverside	150,000
17. Chloroform	NP	Daphnia m.	28,900
		Pink Shrimp	81,500
18. Ethylbenzene	NP	Bluegill [5]	32,000
		M. bahia	87,600
19. 1, 2-Dichloroethane (EDC)	NP	Fathead minnow	118,000
		M. bahia	113,000
20. 1, 1, 1-Trichloroethane	NP	Fathead minnow	52,800
		M. bahia	31,200
21. 1, 1, 2-Trichloroethane	NP	Daphnia m.	18,000
	No data for Marine Water Species		
22. 1, 1, 2, 2-Tetrachloroethane	NP	Daphnia m.	9,230
		M. bahia	9,020
23. 1, 1-Dichloroethylene	NP	Daphnia m.	11,600
		M. bahia	224,000
24. Trichloroethylene	NP	Daphnia p.	39,000
		P. pugio	2,000
25. Tetrachloroethylene	NP	Daphnia m.	8,500
		P. pugio	1,300
26. Toluene	NP	Bluegill	12,700
		P. pugio	9,500
27. Vinyl Chloride	No Aquatic Toxicity Data Reported		
28. Bromoform	NP	Bluegill	29,300
		Sheepshead minnow	17,900
29. Bromodichloromethane	No Aquatic Toxicity Data Reproted		

Toxic Substance	Class [1]	Species [2]	LC50 [3]
30. Methylene Chloride	NP	Fathead minnow	193,000
		M. bahia	256,000
31. Methyl Chloride	NP	Bluegill	550,000
		T. Silverside	270,000
32. Dibromochloromethane	No Aquatic Toxicity Data Reported		
33. 1, 3-Dichloropropene	NP	Bluegill	6,060
		M. bahia	790
34. 2-Chlorophenol	NP	Daphnia m.	2,580
	No Data for Marine Water Species		
35. 3-Chlorophenol	No Aquatic Toxicity Data Reported		
36. 4-Chlorophenol	NP	Bluegill	3,830
		Sheepshead minnow	5,350
37. 2, 3-Dichlorophenol	No Aquatic Toxicity Data Reported		
38. 2, 4-Dichlorophenol	NP	Bluegill	2,020
	No Data for Marine Species		
39. 2, 5-Dichlorophenol	No Aquatic Toxicity Data Reported		
40. 2, 6-Dichlorophenol	No Aquatic Toxicity Data Reported		
41. 3, 4-Dichlorophenol	No Aquatic Toxicity Data Reported		
42. Phenol (total)	NP	Daphnia m.	7,000
		P. pugio	5,800
43. Benzidine	NP	Red Shiner	2,500
	No Data for Marine Water Species		
44. Hexachlorobenzene	No Aquatic Toxicity Data Reported		
45. Hexachlorobutadiene	P	Fathead Minnow	102
		P. pugio	32
47. Chromium III	P	Oyster	10,300

1. P - persistent; application factors - 0.05 (acute), 0.01 (chronic)
   NP - nonpersistent; application factors - 0.10 (acute), 0.05 (chronic)

2. First listed species for Freshwater
   Second listed species for Marine Water

3. LC 50's reported in ug/L, parts per billion

4. Grass shrimp, Palaemonetes pugio

5. Mysid shrimp, Mysidopsis bahia

PROCEDURES FOR HUMAN HEALTH CRITERIA CALCULATION IN LOUISIANA

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May 11, 1994

Introduction

The development of numerical criteria for human health protection follows guidance established by the U.S. Environmental Protection Agency (EPA). This guidance is established in a series of EPA documents including publications in the Federal Register. The approach used in developing the human health criteria for the Louisiana Surface Water Quality Standards was originally described in a Documentation Report for the 1989 Louisiana Water Quality Standards, prepared by the Louisiana Department of Environmental Quality, Office of Water Resources (LDEQ-OWR) in June, 1989.

The basic approach used by LDEQ-OWR to develop numerical water quality criteria for human health involves the review of toxicological data for each substance of concern in state waters. Substances of concern are derived from assessment of monitoring programs for water, fish and sediments, discharge and toxic release data, and other relevant information on state waters including the biennial state Water Quality Inventory (305(b) report). EPA's Integrated Risk Information System (IRIS) is used to establish the latest toxicological information on each substance. If the substance is designated as a carcinogen then the appropriate cancer potency slope factor (SF) is obtained; if it is designated a non-carcinogen, then the reference dose (RfD) is obtained. Bioconcentration factors (BCF) are also reviewed through appropriate data bases and updated if necessary. This information is then combined with other appropriate factors in the risk assessment formula to derive the criteria. Other factors considered in the formula include body weight, risk level, fish consumption, drinking water intake, and incidental ingestion while swimming. Categories of criteria are then developed for each toxic substance for drinking water (Public Water Supplies), non-drinking water, and non-swimming water (Secondary Contact).

For those toxic substances in which no toxicological data are available in the IRIS data base, the primary or secondary standards from the drinking water regulations, if available, may be used to provide a level of human health protection. As a special level of protection for drinking water supplies, taste and odor criteria may be used for

those substances associated with taste and odor problems.

The basic formulas, illustrated below, were obtained from a Federal Register notice, November 28, 1980. Further explanation and description of these guidelines can be found in *Assessing Human Health Risks from Chemically Contaminated Fish and Shellfish: A Guidance Manual*. The 1980 Federal Register notice established the use of 2 liters for the average water consumption and the use of 70 kilograms for an average adult body weight. Carcinogenic SFs and non-carcinogenic RfDs are obtained from EPA's IRIS. The fish consumption rate of 20 grams per day used in the formulas was obtained from the U.S.Department of Agriculture's 1984 National Consumption Statistics. A health risk level of one in a million (10^{-6}) has been established for determining criteria for carcinogens with the exception of dioxin and lindane, which have been assigned a 10^{-5} risk level. Additionally, a SF is figured into the formula if the chemical has been given a cancer classification of A, B1, B2, or C. If the chemical has not yet been shown to be a carcinogen, or, if it has been shown that it is not a carcinogen, then a RfD is used instead of a SF.

For water bodies with the designated use of primary contact recreation (swimming), an incidental ingestion rate is included in the formula. The incidental rate is given by this formula:

$$\frac{250ml}{hour}\ possible\ ingestion \times \frac{5hrs}{wk}\ swimming\ duration \times \frac{6mos}{12mos}\ swimming\ season \times \frac{1week}{7days} = 89 \times \frac{ml}{day} = 0.089\ \frac{liters}{day}\ incidental\ ingestion$$

The following are descriptions of items used in the risk-based formulas:

10^{-6}	= risk level
70 kg	= average adult male body weight
BCF	= bioconcentration factor in L/kg
0.02 kg/day	= national average amount of fish/shellfish consumed daily in kilograms (20 g/day)
SF	= cancer potency slope factor in $mg/kg/day^{-1}$
RfD	= reference dose in mg/kg/day
2 L/day	= national average amount of water consumed daily in liters

The equation for a carcinogen in waters designated as public water supply is:

$$Criteria\ \frac{mg}{L} = \frac{(10^{-6})\ (70kg)}{SF[0.089L/day + 2L/day + (BCF)\ (0.02kg/day)]}$$

The following equation is for a non-carcinogenic chemical in water bodies designated as public water supplies:

$$Criteria\ \frac{mg}{L} = \frac{RfD \times 70\,kg}{0.089\,L/day + 2\,L/day + (BCF)\,(0.02\,kg/day)}$$

The equation for a carcinogen in waters not designated as public water supplies is:

$$Criteria\ \frac{mg}{L} = \frac{(10^{-6})\,(70\,kg)}{SF[0.089\,L/day + (BCF)\,(0.02\,kg/day)]}$$

The equation for a non-carcinogen in waters not designated as public water supplies is:

$$Criteria\ \frac{mg}{L} = \frac{RfD \times 70\,kg}{0.089\,L/day + (BCF)\,(0.02\,kg/day)}$$

The equation for a carcinogen in non-drinking waters with secondary contact recreation (no swimming use) is:

$$Criteria\ \frac{mg}{L} = \frac{(10^{-6})\,(70\,kg)}{SF[(BCF)\,(0.02\,kg/day)]}$$

The equation for a non-carcinogen in non-drinking waters with secondary contact recreation (no swimming use) is:

$$Criteria\ \frac{mg}{L} = \frac{RfD(70\,kg)}{BCF(0.02\,kg/day)}$$

For excepted use water bodies, special procedures for calculating site-specific criteria may be used. In general, for water bodies with the primary contact recreation use removed, the incidental ingestion rate for water will also be removed from the equation. Most states do not have an incidental ingestion rate for swimmers, and, even so, most of Louisiana's human health criteria will be more stringent than other states. A use attainability analysis may show that a special water body supports only a limited fishery use. The fish population in this type of water body is not composed of typical sport fish for consumption. Instead, the fish are usually small and

inappropriate for human consumption. Therefore, for excepted use water bodies, Louisiana will use the national fish consumption rate of 6.5 grams per day, or another suitable fish consumption rate, rather than the usual 20 grams per day. Since many states use this or other fish consumption rates, Louisiana criteria for this type of water body will still be comparable to the human health criteria of other states.

Modifying the Criteria

Because toxicological information is subject to change, the scientific data must be checked periodically and updated, if necessary. Occasional comparisons of 1) EPA's IRIS and 2) the appropriate, most current criteria documents to LDEQ's human health criteria spreadsheet will facilitate any modifications to any particular criterion. If any of the criteria needs modifying, changes can most easily be made through the already established QUATTRO PRO spreadsheet.

Accessing the Spreadsheet

(Note: These instructions are written to enter the spreadsheet with a MOUSE. If one wishes to work within QUATTRO PRO strictly using his/her keyboard, he should use the ?/ key in conjunction with the arrow and ENTER key.)

To access the spreadsheet, at the C prompt type — cd QPRO

At the C:\QPRO > prompt, type — Q

Once in the spreadsheet, click on — FILE then — RETRIEVE

Click on the file named — TOXICCAL.WK2

YOU ARE NOW IN THE LDEQ HUMAN HEALTH CRITERIA TABLE.

To Make Changes to Parameters

Move cursor to desired cell (parameter-column and chemical-row), type in correction, and press ENTER

Screen will blink twice and new number(s), and new criteria, will appear.

To Edit the Formulas (for columns J, K, and L)

Arrow over to either column J, K, and/or L. Press F2 then use both the ← → keys and DELETE to make desired changes.

To keep changes, press ENTER.
(NOTE: IF YOU HAVE MADE UNDESIRABLE CHANGES, PRESS ESC TWICE TO START EDITING PROCESS OVER.)

To Print

Click on PRINT then BLOCK.

Once in BLOCK then type A3..M58 (or the line corresponding to the last chemical) and press ENTER.

To View New Table in Print Mode

a) In PRINT menu, click on DESTINATION. Next click on SCREEN PREVIEW.

b) With desired BLOCK (Axx..Nxx) entered, click on SPREADSHEET PRINT. Entire table will now appear on the screen.

c) To see table better, click on ZOOM(+) and CLICK-DRAG Red Box to desired part of the screen to check for corrections made.

d) Click on UNZOOM(-) then QUIT to return to PRINT menu.

e) If part of table did not show, click on LAYOUT then PERCENT SCALING.

f) Type in a reasonable value and press ENTER.

g) Click on QUIT.

h) Repeat steps b-g until desired appearance of table is achieved.

Click on DESTINATION once more; then on GRAPHICS PRINTER.

Click on SPREADSHEET PRINT.

YOUR NEW TABLE IS NOW PRINTING

To Save/Exit the Spreadsheet

IF YOU WANT TO SAVE YOUR CHANGES:
To save changes to existing file name, click on FILE menu then SAVE AS then ENTER.

IF YOU WANT TO SAVE YOUR CHANGES UNDER A NEW FILE NAME:
Follow the previous step.
Type in the new name before pressing ENTER (QUATTRO PRO REQUIRES NAME TO BE XXXXXXXX.WKX).

IF YOU DO NOT WANT ANY CHANGES SAVED AND/OR YOU WANT TO EXIT THE SPREADSHEET:
Click on FILE then EXIT.

THIS STEP WILL EXIT YOU FROM THE SPREADSHEET AND QUATTRO PRO WITHOUT SAVING ANY CHANGES MADE TO THE TABLE.

(IF THERE ARE ANY SPECIFICS YOU WANT DONE TO THE TABLE, PLEASE CONSULT THE QUATTRO PRO MANUAL.)

Adopted Dioxin Criteria
October 1991

Table A. Calculations used to derive the proposed 1991 dioxin (2,3,7,8-TCDD) criteria for the Louisiana Surface Water Quality Standards.

ASSUMPTIONS				CRITERIA[1]	
BCF[2]	FCR[3]	SF[4]	Risk Level	Drinking Water	Non-Drinking Water
5,000	20	9,700	10^{-5}	0.71	0.72

[1] Criteria expressed in parts per quadrillion (ppq)
[2] BCF = Bioconcentration Factor (L/Kg)
[3] FCR = Fish Consumption Rate (g/day)
[4] SF = Cancer Slope Factor (mg/Kg/day)
[5] DEQ 1989 revision includes 0.089 L/day incidental water ingestion for both drinking water and non-drinking water; an additional 2 L/day used only on drinking water
[6] 70 Kg = Average adult body weight

$$\text{Drinking Water (ppq)} = \frac{(10^{-5})(70\ \text{kg})^{6}}{\text{SF}\,[0.089\ \text{L/day} + 2\ \text{L/day} + (5{,}000\ \text{L/kg})(\text{FCR kg/day})]}$$

$$\text{Non-Drinking Water (ppq)} = \frac{(10^{-5})(70\ \text{kg})}{\text{SF}\,[0.089\ \text{L/day} + (5{,}000\ \text{L/kg})(\text{FCR kg/day})]}$$

APPENDIX B-2: Rationale for Development of Numeric Targets in Louisiana 303(d) Streams Listed for Pesticides

The Environmental Protection Agency(EPA), Region 6, Water Quality Protection Division has developed numeric targets for pesticides, identified through analytical measurements, to evaluate the need for development of Total Maximum Daily Loads (TMDL) in waterbodies identified and listed as not in attainment of the State of Louisiana water quality standards, as required under §303(d) of the Clean Water Act (CWA). This action was necessary to both evaluate the need for TMDL development and as a goal when a TMDL is required. The development of the numeric targets has been performed without prior knowledge of the analytical values obtained by the Louisiana Department of Agriculture and Forestry (LDAF) through water quality monitoring. The list of analytes was reviewed by senior staff and management in the EPA Region 6, Multimedia Planning and Permitting Division, which provided Chemical Abstract Service (CAS) numbers and product names for each pesticide. Where the State of Louisiana has established water quality criteria, those criteria were used for screening. Where the EPA has developed (or drafted but not finalized) recommended aquatic life protection criteria for a pesticide, but the State of Louisiana had not adopted the criteria, the EPA recommended criteria was used as a numeric target. For all other measured pesticides numeric targets were established in accordance with the State of Louisiana Water Quality Standards and established procedures submitted to EPA Region 6.

In accordance with LAC 33:IX.1113.C.6.b., acute and chronic aquatic life values were developed, based on information contained in EPA's ECOTOX (ecological toxicity) database and from EPA's Office of Pesticides database, supplied by the Region 6 Multimedia Planning and Permitting Division, Pesticides Section. LAC 33:IX.1113.C.6.b. states;

> "The criteria for protection of aquatic life are based on acute and chronic concentrations in fresh and marine waters as specified in the EPA criteria documents and are developed primarily for attainment of the fish and wildlife propagation use. Where a specific numerical criteria is not derived in EPA criteria documents, a criterion is developed by applying an appropriate application factor for acute and chronic effects to the lowest LC_{50} value for a representative Louisiana species."

In implementing this provision EPA reviewed the available data and used the lowest 48-hour LC_{50} values for invertebrate species indigenous to Louisiana, and the lowest 96-hour LC_{50} values for vertebrate species indigenous to Louisiana. EPA utilized application factors of 0.1 for acute criteria and 0.05 for chronic criteria, in accordance with the document submitted to EPA Region 6 *"Documentation of Numerical Criteria for Acute and Chronic Aquatic Life Protection in the 1989 Water Quality Standards Revisions"*, dated June 1989. Where multiple data points were available the geometric mean was utilized for test data points. Data from different sources was evaluated to determine if concentrations were measured analytically or were based on a formulation and a dilution calculation, with a preference for measured concentrations. However; if only calculated concentrations were available, based on formulated products and calculated concentrations, that data was used in determining the acute and chronic numeric targets (products of LC_{50} and application factor).

For the compound Fipronil EPA contacted the US Department of Agriculture and Louisiana State University (LSU) to obtain information concerning the effects of Fipronil to crayfish, based on complaints of the adverse effects this pesticide was having on crayfish farming. At this time LSU is conducting toxicity tests using crayfish and examining the effects on different life stages and size. Because some of the degradation products of Fipronil are more toxic than the parent compound, establishing a numeric target that considers the toxicity of the parent compound and the degradation products will be difficult and time consuming. For the purpose of this activity, data from the EPA database was used in establishing a numeric target for aquatic life protection.

No calculations were necessary for pesticides that have Louisiana adopted water quality criteria for aquatic life protection or for EPA recommended water quality criteria for the protection of aquatic life. Numeric targets developed for the remaining pesticides were established using the following formulae:

Acute numeric target = (LC_{50}) X 0.1

Chronic numeric target = (LC_{50}) X 0.05

Example Calculation:

Acute numeric target for fipronil = 45.6 µg/l (LC_{50} for *Lepomis macrochirus)* X 0.1
= 4.6 µg/l

Chronic numeric target for fipronil = 45.6 µg/l (LC_{50} for *Lepomis macrochirus*) X 0.05
= 2.3 µg/l

APPENDIX C: EPA pesticide study lab results

Table 1. EPA Pesticide Study: Carbofuran Lab Results

Site Description	Subsegment #	USGS Site #	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01
Ouachita River (Arkansas State Line)*		1.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Ouachita River- Arkansas State Line to Columbia L&D.	80101	1.2	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Ouachita River- Columbia L&D to Jonesville	80201	2.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Black River- Jonesville to COE Structure at Serena (Mile 25)	80301	3.1	0.04	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Ouachita River Basin	80302	4.1	0.03	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Bayou Bonne Idee- Headwaters to Boeuf River	80902	5.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Turkey Creek- Headwaters to Big Creek (inc. Glade Slough)	80905	6.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Crew Lake	80909	7.1	< 0.031	< 0.031	< 0.031	0.04	< 0.031	< 0.030
Clear Lake	80910	8.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	0.88	0.95	0.19	< 0.031	< 0.031	< 0.030
Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	0.44	0.17	< 0.031	< 0.031	< 0.031	< 0.030
Lake St. Joseph (Oxbow Lake)	81202	11.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Bayou Louis	80202	12.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Bayou Bartholomew (Arkansas State Line)*		13.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Bayou Bartholomew- Arkansas State Line to Dead Bayou	80401	13.2	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	ns
Boeuf River (Arkansas State Line)*		14.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	0.14	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	< 0.031	< 0.031	< 0.031	0.16	< 0.031	< 0.030
Bayou Lafourche- Near Oakridge to Boeuf River nr. Columbia	80904	16.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Bayou Macon (Arkansas State Line)*		17.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030
Bayou Macon- Arkansas State Line to Tensas River	81001	17.2	0.58	0.05	< 0.031	< 0.031	< 0.031	< 0.030
Lake Bruin (Oxbow Lake)	81203	18.1	< 0.031	< 0.031	< 0.031	< 0.031	< 0.031	< 0.030

* State Line Station, ns = no sample collected, highlighted cells = exceedance in numeric target for aquatic life protection (0.13 ug/l), Reporting Limit 0.03 ug/l

Table 2. EPA Pesticide Study: DDT Lab Results

Site Description	Subsegment #	USGS Site #	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01
Ouachita River (Arkansas State Line)*		1.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ouachita River- Arkansas State Line to Columbia L&D.	80101	1.2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ouachita River- Columbia L&D to Jonesville	80201	2.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Black River- Jonesville to COE Structure at Serena (Mile 25)	80301	3.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ouachita River Basin	80302	4.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Bayou Bonne Idee- Headwaters to Boeuf River	80902	5.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Turkey Creek- Headwaters to Big Creek (inc. Glade Slough)	80905	6.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Crew Lake	80909	7.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Clear Lake	80910	8.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	0.0024	0.0015	< 0.001	< 0.001	< 0.001	< 0.001
Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	0.0024	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Lake St. Joseph (Oxbow Lake)	81202	11.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Bayou Louis	80202	12.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Bayou Bartholomew (Arkansas State Line)*		13.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Bayou Bartholomew- Arkansas State Line to Dead Bayou	80401	13.2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	ns
Boeuf River (Arkansas State Line)*		14.1	0.0012	< 0.001	0.0044	< 0.001	< 0.001	< 0.001
Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	0.0021	< 0.001	0.0015	< 0.001	< 0.001	< 0.001
Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	0.0047	< 0.001	0.0018	< 0.001	< 0.001	< 0.001
Bayou Lafourche- Near Oakridge to Boeuf River nr. Columbia	80904	16.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Bayou Macon (Arkansas State Line)*		17.1	< 0.001	< 0.0012	< 0.001	< 0.001	< 0.001	< 0.001
Bayou Macon- Arkansas State Line to Tensas River	81001	17.2	0.0038	0.0022	< 0.001	< 0.001	< 0.001	< 0.001
Lake Bruin (Oxbow Lake)	81203	18.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

* State Line Station, ns = no sample collected, highlighted cells = exceedance in water quality standard for human health protection (0.001 ug/l), Reporting Limit 0.001 - 0.002 ug/l

Table 3. EPA Pesticide Study: Methyl Parathion Lab Results

Site Description	Subsegment #	USGS Site #	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01
Ouachita River (Arkansas State Line)*		1.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ouachita River- Arkansas State Line to Columbia L&D.	80101	1.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ouachita River- Columbia L&D to Jonesville	80201	2.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Black River- Jonesville to COE Structure at Serena (Mile 25)	80301	3.1	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01
Ouachita River Basin	80302	4.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Bayou Bonne Idee- Headwaters to Boeuf River	80902	5.1	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01
Turkey Creek- Headwaters to Big Creek (inc. Glade Slough)	80905	6.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Crew Lake	80909	7.1	< 0.01	< 0.01	< 0.01	0.02	0.02	< 0.01
Clear Lake	80910	8.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	< 0.01	< 0.01	0.01	< 0.02	< 0.01	< 0.01
Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01
Lake St. Joseph (Oxbow Lake)	81202	11.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Bayou Louis	80202	12.1	< 0.01	< 0.01	< 0.01	< 0.01	0.31	< 0.01
Bayou Bartholomew (Arkansas State Line)*		13.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Bayou Bartholomew- Arkansas State Line to Dead Bayou	80401	13.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	ns
Boeuf River (Arkansas State Line)*		14.1	< 0.01	< 0.01	0.02	0.02	0.02	< 0.01
Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01
Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	0.28	0.01	< 0.01	< 0.01	0.04	< 0.01
Bayou Lafourche- Near Oakridge to Boeuf River nr. Columbia	80904	16.1	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01
Bayou Macon (Arkansas State Line)*		17.1	0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01
Bayou Macon- Arkansas State Line to Tensas River	81001	17.2	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01
Lake Bruin (Oxbow Lake)	81203	18.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

* State Line Station, ns = no sample collected, highlighted cells = exceedance in numeric target for aquatic life protection (0.13 ug/l), Reporting Limit 0.01 ug/l

Table 4. EPA Pesticide Study: Toxaphene Lab Results

Site Description	Subsegment #	USGS Site #	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01
Ouachita River (Arkansas State Line)*		1.1	< 0.062	< 0.060	< 0.061	< 0.061	< 0.061	< 0.061
Ouachita River- Arkansas State Line to Columbia L&D.	80101	1.2	< 0.060	< 0.060	< 0.060	< 0.061	< 0.061	< 0.061
Ouachita River- Columbia L&D to Jonesville	80201	2.1	< 0.060	< 0.060	< 0.060	< 0.060	< 0.061	< 0.061
Black River- Jonesville to COE Structure at Serena (Mile 25)	80301	3.1	< 0.061	< 0.060	< 0.061	< 0.061	< 0.061	< 0.061
Ouachita River Basin	80302	4.1	< 0.060	< 0.061	< 0.061	< 0.061	< 0.061	< 0.061
Bayou Bonne Idee- Headwaters to Boeuf River	80902	5.1	< 0.060	< 0.061	< 0.060	< 0.060	< 0.061	< 0.060
Turkey Creek- Headwaters to Big Creek (inc. Glade Slough)	80905	6.1	< 0.060	< 0.060	< 0.060	< 0.060	< 0.061	< 0.060
Crew Lake	80909	7.1	< 0.061	< 0.061	< 0.060	< 0.060	< 0.061	< 0.060
Clear Lake	80910	8.1	< 0.060	< 0.060	< 0.061	< 0.060	< 0.061	< 0.061
Joe's Bayou- Headwaters to Bayou Macon	81002	9.1	< 0.060	< 0.060	< 0.061	< 0.060	< 0.061	< 0.060
Tensas River- Headwaters to Jonesville (inc. Tensas Bayou)	81201	10.1	< 0.061	< 0.060	< 0.061	< 0.060	< 0.061	< 0.061
Lake St. Joseph (Oxbow Lake)	81202	11.1	< 0.060	< 0.060	< 0.061	< 0.060	< 0.061	< 0.061
Bayou Louis	80202	12.1	< 0.060	< 0.061	< 0.060	< 0.060	< 0.061	< 0.060
Bayou Bartholomew (Arkansas State Line)*		13.1	< 0.061	< 0.060	< 0.060	< 0.060	< 0.061	< 0.060
Bayou Bartholomew- Arkansas State Line to Dead Bayou	80401	13.2	< 0.060	< 0.061	< 0.060	< 0.060	< 0.061	ns
Boeuf River (Arkansas State Line)*		14.1	< 0.061	< 0.060	0.103**	< 0.060	< 0.061	< 0.060
Boeuf River- Arkansas State Line to Ouachita River	80901	14.2	0.0780	< 0.060	< 0.061	< 0.061	< 0.061	< 0.060
Big Creek- Headwaters to Boeuf River (incl. Colewa Bayou)	80903	15.1	< 0.060	< 0.060	< 0.060	< 0.060	< 0.061	< 0.060
Bayou Lafourche- Near Oakridge to Boeuf River nr. Columbia	80904	16.1	< 0.061	< 0.060	< 0.060	< 0.060	< 0.061	< 0.060
Bayou Macon (Arkansas State Line)*		17.1	< 0.061	< 0.072	< 0.060	< 0.060	< 0.061	< 0.060
Bayou Macon- Arkansas State Line to Tensas River	81001	17.2	0.0697	< 0.060	< 0.060	< 0.060	< 0.061	< 0.060
Lake Bruin (Oxbow Lake)	81203	18.1	< 0.060	< 0.060	< 0.061	< 0.061	< 0.061	< 0.061

* State Line Station, ** Average of both columns in GC/ECD analysis, ns = no sample collected, highlighted cells = exceedance in water quality standard for human health protection (0.0024 ug/l), Reporting Limit 0.06 ug/

APPENDIX D: LDAF Quarterly Ambient Monitoring Data (May 1998 – Jun 2001)

Station	Compound	Numeric Target	Year	First Quarter			Second Quarter			Third Quarter			Fourth Quarter		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
WM-S-M-01	Carbofuran	0.13	2000					0.650							
WM-S-M-03	Carbofuran	0.13	2000					0.580							
WM-S-M-03	Methyl Parathion	0.17	1999								0.300				
WM-S-M-05	Methyl Parathion	0.17	2000								0.220				

highlighted cells = exceedances in numeric target Note: LDAF only reports values when they exceed the minimum detection level.

APPENDIX E: Tensas River Data from USGS NAWQA Study (June 1998 – Jan 2000)

STATION NUMBER	STATION NAME	DATE	82674 CARBOFURAN FIL. (ug/l)	82667 METHYL PARATHION (ug/l)
	Numeric targets →		0.13	0.17
07369500	TENSAS R @ TENDAL, LA	5/12/98	E.248	<.0060
07369500	TENSAS R @ TENDAL, LA	6/16/98	E.366	<.0060
07369500	TENSAS R @ TENDAL, LA	7/14/98	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	8/18/98	<.0030	0.079
07369500	TENSAS R @ TENDAL, LA	9/14/98	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	10/14/98	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	11/17/98	<.100	<.0060
07369500	TENSAS R @ TENDAL, LA	12/7/98	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	2/16/99	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	3/15/99	E.806	<.0060
07369500	TENSAS R @ TENDAL, LA	4/29/99	E.332	<.0060
07369500	TENSAS R @ TENDAL, LA	5/13/99	E.367	<.0060
07369500	TENSAS R @ TENDAL, LA	6/16/99	E.346	<.200
07369500	TENSAS R @ TENDAL, LA	7/27/99	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	8/26/99	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	9/8/99	<.0030	<.400
07369500	TENSAS R @ TENDAL, LA	10/7/99	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	11/1/99	E.0188	<.0060
07369500	TENSAS R @ TENDAL, LA	12/28/99	<.0030	<.0060
07369500	TENSAS R @ TENDAL, LA	1/12/00	<.0030	<.0060

highlighted cells = exceedance in the numeric target for carbofuran and methyl parathion